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September 15, 1927

SEP 17 1927

Engineering News-Record

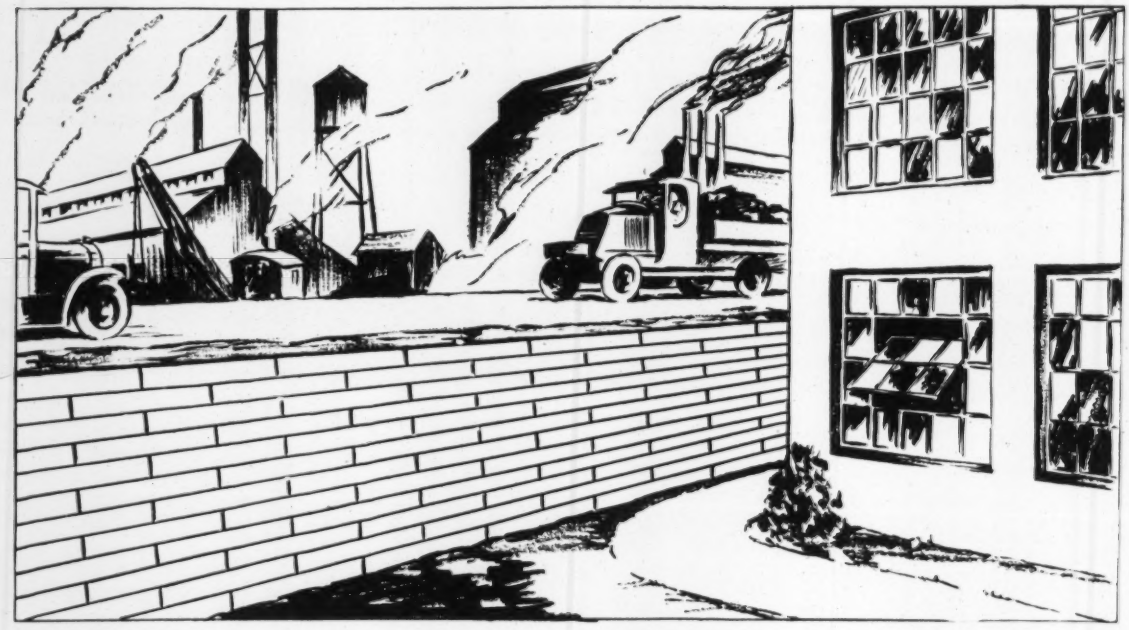
Laying Screw-Joint Pipe for Oil Transmission in California

Railway Track Recording Car Uses Gyroscope

New York Canal Terminals Designed for Rapid Cargo Handling

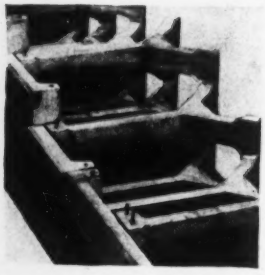
Oil Production Engineering in California

Winter Construction: 3-*Winter Excavation and Embankment Construction*



Around the Industrial Plant

This Cribbing Makes Ideal Retaining Walls



Note the Y-shaped headers which interlock with the stretchers and form a cellular wall of great strength. This construction holds the backfill without the use of a third member in the bank.

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FRANK C. WIGHT
Editor

Volume 99 NEW YORK, SEPTEMBER 15, 1927 Number 11

Effective Channel Control

THAT well planned channel control may be highly effective is shown by the results obtained at the mouth of the Columbia River near Astoria, Ore., as outlined in a brief note elsewhere in this issue. The work of obtaining a 40-ft. channel 600 ft. wide was completed in 1916, after years spent in dredging and building jetties to direct the current toward maintaining the deepened channel. In the 11 years that have elapsed since then, the expectations of the engineers who designed the training works have been more than fulfilled. The channel not only has deepened itself but has also become very much wider. The results are a credit to the army engineers who laid out the training works.

Protecting Construction from Fire

RECOLLECTION played the editor false last week when he wrote in the editorial entitled "Construction Fire Hazards" that a New York court had ruled that concrete forms and struts were contractor's tools. In the case which was in mind that contention was so strongly argued by the owner of a building which had been burned during construction that a number of contractors who knew about the controversy became convinced that there might be danger of such a ruling if the case, or a similar one, did come to trial and they therefore began then to take the precaution of seeing in every building they erect that all of their plant and appurtenances are covered by insurance. This is by no means general practice, however. Many builders have not awakened to the risk they run from fire and such cases as the Pittsburgh bridge should be a warning.

Following Up a Bluff

CHICAGO's city fathers do not seem to be quite so brash in defying the United States government as the mayor is. The city council has not yet approved the mayor's plan to substitute water-waste surveys, conducted by plumbers, incidentally, for the metering program ordered by the War Department. And now the council's finance committee, wondering perhaps if it did not go too far in favorably reporting the mayor's scheme, has been down to Washington to see if the Department really meant what it said when it ordered 100 per cent metering in ten years. General Jadwin's remarks to the committee are abstracted in the news columns of this issue. They should leave no doubt in the mind of Mr. Thompson that bluffing the United States has dangerous connotations if carried too far. The Department evidently is willing to consider an honest discussion of the provisions of the famous metering order, but it does not consider that such a discussion can be entered into so long as Chicago continues to evade the order and, unofficially but unmistakably, defy the government. After listening to the calm statement of the case by the Chief of Engineers, it may be that the Chicago aldermen went back home with some queries in their mind as to the seriousness of getting in contempt of the United States Supreme Court, at whose instance the War Department order on metering was issued.

Overflowing Reservoirs

DAILY newspaper reporters and editors quite generally assume that an overflowing water storage reservoir indicates culpable waste which should have been prevented by providing more storage capacity. It would be as reasonable to hold that a reservoir only partly full in a dry period is too large and represents a money waste in construction cost. Happily the recent wet season has filled the Croton reservoirs of New York City to overflowing and has replenished the Ashokan reservoir in the Catskills. It has filled some or all of the Pequannock reservoirs from which Newark, N. J., is supplied, and has done the same thing in Massachusetts for the Boston metropolitan district. One or more New York dailies have commented in stock fashion on the waste of water overtopping the Croton dam. The schools of daily journalism might well have an occasional lecture by a competent engineer on the function and limitations of storage reservoirs, the relations between floods and epidemics and some other topics on which the daily press goes constantly astray in its straining for the sensational.

Insurance Against Dynamiting

INSURANCE covering damage to the Owens River aqueduct due to "explosions, riot and civil commotion" to the amount of $7,500,000 and continuing for a period of one year has been taken out recently by the board of water and power commissioners of Los Angeles. This coverage, which is in addition to $15,000,000 in fire insurance spread over properties of the water and power departments of Los Angeles, was deemed necessary primarily because of the danger from dynamiters. For years the feud between the city and people of Owens Valley has broken out in violence every now and then, more recently in the form of dynamitings that for a while this summer recurred persistently despite armed guards and a continuous patrol along the aqueduct. Even though there are storage reservoirs near the city that would assure continuity of service during any brief shutdown of the aqueduct supply, the civic authorities in responsible charge will always feel great uneasiness when the water supply, the very life blood of the community, is repeatedly cut off even for short periods. It is to be noted that despite the storage capacity near the city, the repairs of dynamited sections of the aqueduct are handled as ultra rush jobs. Under these conditions $7,500,000 is not a large amount of insurance. Insurance against wrecking of highway toll bridges is now an accepted

practice and in some parts of the country banks will not loan on office buildings that do not carry insurance against earthquake damage. Obviously the trend is toward more complete insurance protection of important engineering structures—another indication of the increasing appreciation in the business world of the importance attaching to the engineer's work.

Stock Exchanges and Contractors

RECENTLY the owners of a large building under construction were discussing their contractor. This contractor is an old and favorably known firm with a long line of successes behind it, and with a trained staff of engineers and superintendents. But the owners were not satisfied with the work it was doing. In execution everything was good; they were getting an admirable building. But there were constant squabbles about the performance. The contractor conceded nothing and fought all suggestions. Life for the owners was being made miserable by the eternal bickering over contract provisions and the attempt of the contractor to evade responsibility for error or change. The worst of the thing was that the contractor in some earlier work had not shown any of these peculiarities, but had always been willing to play fair and to act as though he expected to do work some future time for the same owner. Now all he seemed to care about was profit on this immediate job. And for this change the owners had one explanation. The contractor was now an incorporated company with its shares listed and freely traded in on the exchange. Where before, said these owners, the company was closely held and a few people could be persuaded that long time profits were the result of continued good will, now the directors had to look at each quarter's report with one eye on the ticker. The story is repeated here for what it is worth.

Marked Men

FIVE young American engineers are now in Europe, through the generosity of John R. Freeman and under the auspices of the Freeman Traveling Fellowship, making intensive studies in the European, and especially the German, methods of river control hydraulics. As he has made well known in many public pronouncements Mr. Freeman believes that this country is behind Europe in the empirical investigation of river hydraulics. He feels that American engineers have been too closely concerned with the actual behavior of one river, and not enough interested in the basic phenomena, which might be studied by aid of small-scale laboratory reproduction. The plausibility of this contention is evident enough, though there is something to be said also for the other side. However that may be, the excursion of these young men into continental research is very hopeful. Engineers and educators are agreed that whatever the requirements for the average engineer there will always be a need for a few intensively educated men who will go beyond the regime prescribed for the engineer and explore the great unknown area that lies beyond common practice. In the fellowships that he has provided Mr. Freeman is assuring a valuable experiment in engineering education. We may have to wait a decade or two to find out how these young men turn out and what they contribute to the art and the science of engineering, but they are marked men now and their careers will be watched with interest.

Back to Checks and Balances

BUFFALONIANS have good reason to try to get better city government than they have had under the commission plan for a dozen years past. Whether they will get it by reverting to checks and balances, ward representation and party primaries, as they voted to do on Aug. 29, is open to question. Less reliance on some formula of government and more attention to putting competent men in office and insisting on efficient service would give more promise of improvement.

If the charter framers were aiming at a separation of legislative and executive functions, as has been claimed, they have fooled themselves and, if the voters thought they were getting it, the people also. Partial separation there is, but partial only. The council can block all the mayor's appointments. The mayor can veto all legislation, except the final shaping and fixing of the budget. The mayor has unlimited power to investigate city affairs, but so has the council. The only complete executive power the mayor seems to have is to remove his departmental head appointees, but he can put no one in their place without the approval of council.

Only a small percentage of the administrative staff is appointed by the mayor. Sub-department or bureau and division chiefs are appointed by the mayor's appointees and thus are not under control of the mayor except indirectly by the removal of their superior officers, but these, as stated, cannot be replaced without consent of council. Such of the administrative staff as is subject to appointment after civil service examinations is removable under charges, after hearing, but here the mayor shares power with the comptroller and the president of the council, the latter primarily a legislative official.

In one respect there is an almost complete separation of legislative from executive and administrative functions. Councilmen do not head executive departments, as under the commission plan, a grave evil of commission government, exemplified again and again at Buffalo and elsewhere.

Had Buffalo wished a real separation of powers, two plans were available: The commission manager or the mayor-council, with the mayor absolutely restricted to executive and the council to legislative functions. The mayor would have had no legislative power, through the veto, and the council no executive power, through confirmation of the mayor's appointments.

Respects in which the Buffalo charter (see outline in our issue of Sept. 1, p. 358) does not go back or clear back to old ways are in there being only three elective officers besides councilmen; and a relatively small council, for so large a city as Buffalo, with 6 of the 15, including the president, chosen at large. The ward representation, mentioned at the outset of this discussion, is curtailed in number by combining three wards into a district.

If the charter framers and voters of Buffalo were unwilling to retain complete election at large, then rather than go backward to district representation they might have been progressive and used proportional representation. But that would not have accorded with the evident desire to go back to the party primary, which presumably was a dominant force in bringing about the framing of a new charter and in rolling up a majority of 3 to 2 for its adoption in a total vote of 53,000. What the 100,000 voters who did not go to the polls think of

the new charter is an interesting subject for speculation. Evidently they were not much worried over such matters as forms of government and were quite willing to let those concerned settle the matter as inclination and chance might decide.

Station Work Grading

WITH modern grading equipment in its multitude of forms developed to high perfection, attention is attracted by any occasion where for a considerable operation reversion is taken to the primitive method of pick and shovel with wheelbarrow and horse cart haulage. So the station-work grading, described in this issue, along the bluffs of the Illinois River, is one of the interesting features of that piece of highway construction. Railway construction furnishes a wealth of proof of the effectiveness of station work in grading roadbed for ties and rails. There are no conditions radically different in grading for highways.

The essential question that arises is not of the efficiency of station work but is: Why did power grading machines and power haulage give way to the hand shovel and the horse cart? The answer is: Inaccessible terrain for equipment and supplies; heterogeneous character of earth and rock excavation; and availability of local labor for manning and equipping many stations. Perhaps the last condition was of controlling influence. There remain the facts, however, that grading machinery must have uniformity of material, volume enough of work for quantity production and easy servicing both in the matter of supplies and in that of taking away excavated material if the machine is to demonstrate its greatest economy over hand labor. On this Illinois road work about every condition was against the high effectiveness of power graders and power hauling units. On the other hand, the hills were full of small farmers all with a team and a couple of boys or a hired man ready to take a cash job of handling a few hundred yards of grading as their own bosses on a make-what-you-can proposition. The occasions are few in modern heavy earth moving operations where the station worker can beat the power grader, but the Illinois road work described seems to have been one of them.

Railroad Track Inspection

TRACK inspection is becoming more and more a mechanical operation wherein a continuous record of track conditions is substituted for the hit-and-miss notebook records kept by roadmasters or division engineers. It is a long jump from such an incomplete record to the continuous one showing at a glance the gage, whether wide or tight, the low joints and the cross-level conditions of the track, a record made possible by the gyroscopic track recording car described on p. 428 of this issue.

In the application of the governing properties of the gyroscope to control the mechanism of a track-recorder car an important step has been made toward increasing the accuracy and value of these automatic records of track conditions. In such apparatus one of the difficulties has been to secure accurate records of cross level, showing the inclination of car body and the superelevation of outer rail on curves. The gyroscope, which has been adapted successfully and extensively for such varied service as controlling nautical compasses, controlling the fire of a warship's guns, and acting as a stabilizer in steamships and airplanes, had obvious advantages as a remedy, but it developed upon investigation that when a railway train at high speed enters a sharp curve, the internal forces set up are much greater than those encountered in gyroscopic control of ships or airplanes. After experimental study, however, the device was successfully adapted to eliminate the interference due to swaying of the car body.

The development of track recorders has come about only through the many experiments carried on by the various railroads of the country beginning with crude gage-testing machines laboriously drawn along at the rear of a hand car from which the division engineer or roadmaster watched the gage indicator and noted the "worst places" in his book, and passing through Dr. P. H. Dudley's "dynagraph" car, in effect a similar gage tester attached to a coach in which a continuous record of the gage was roughly sketched on a moving tape and on which some attempt was made to get a record of cross-level track conditions, to the present gage-testing car.

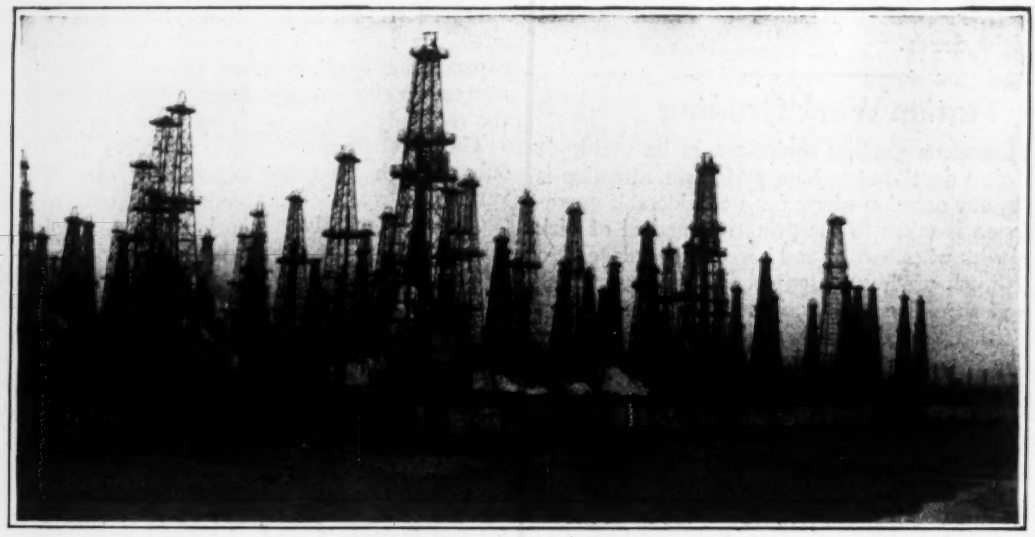
That is a notable advance and one of which railroad men may well be proud. There is, however, one warning note which should be sounded. Such a car will produce a more accurate record of track conditions than can a roadmaster or track supervisor with a hand gage and level, but its movement over a division can never have the same effect upon the track men as having the roadmaster, and occasionally the division engineer, come over the track section on foot trying the gage and level by hand and observing conditions which no machine can see. The best machine should not be permitted to become a means of reducing personal contact with the section gangs.

Publicity as an Asset

IN THE publicity methods which have been employed by engineers of local improvement projects, the main purpose in many cases has been simply to inform and interest the people for whose benefit the project is being carried out. Too often the engineer may forget that he has an obligation to develop a favorable public opinion as a potential support of the project in the event of political or other interference or opposition. It is just as important to send frequent statements to the local papers outlining in non-technical language the purpose of the project, its features, its benefits to the people, the progress of the work, and the difficulties or delays encountered, together with notes as to the officials, engineers, contractors and others concerned. The local papers will use the statement sometimes complete, sometimes only as a short filler.

But the engineer should also cultivate an ability to speak in public on his work, in non-technical language. He will find that he has frequent opportunities to explain the project before local boards, clubs and other organizations. The net result of these outside activities should be to develop public interest in and appreciation of the project, since the general public is kept informed as to the purpose and progress of the work which is being paid for by taxes and bond issues. This is legitimate activity. It has a definite purpose beyond mere publicity or public information, for in case political interference should develop, or a diversion or stoppage of funds that might hamper the progress of the work, the existence of a real public opinion favorable to the project will be a powerful aid. The engineer in charge of work ought to believe that work necessary and be willing to fight to prove it.

One of a Series of Articles on
OIL FIELD ENGINEERING



A Result of Town Lot Drilling Along Huntington Beach

Oil Production Engineering in California

The Engineer's Place Well Established—Stabilized Operations Afford Engineer Wide Field for Service of High Order

By N. A. Bowers
Pacific Coast Editor, *Engineering News-Record*

IN CALIFORNIA the oil industry is more than fifty years old and is said to have cut its eye-teeth. Long experience has made it possible to stabilize operations and to work out highly economical methods that have helped to gain for the oil companies of California an enviable reputation for efficiency, economy and progressive ideas. Oil booms occur there as they do in other fields, but they are not dominating factors in production as the combined output from fields of the boom class has been only 15 to 20 per cent of the state total.

Boom fields get disproportionate publicity, unfortunately, thus giving the public an erroneous idea of the industry as a whole. Human nature varies but little the world over and an oil discovery in California that affects a number of land owners is invariably followed by a wild stampede, "town-lot drilling," economic waste and financial loss such as universally attend competitive drilling and inexperienced operation. Early this year, within a few weeks after the discovery of oil at Alamitos Heights, near Long Beach, 156 wells were located on 83 acres, making one of the most congested fields California has ever known. There were two occasions in this field on which adjacent wells actually ran into each other between 3,000 and 4,000 ft. down.

To the engineer, however, the booms mean little and the long history of commercial production means much. Long experience in oil production has made the industry appreciative of the engineer. His place is now established and he has opportunity for service of a high order. In the early days of the industry even the larger operations involved enormous waste, but now a very different policy prevails, methods have been greatly improved and present standards rate high in efficiency and economy.

Gas that was once wasted by millions of cubic feet is now piped long distances to a market; where at first there was reckless spending for anything that would speed production of oil, ways and means of avoiding unnecessary losses have been studied and compared, and there is an earnest search for the most effective methods. Some authorities place the oil taken out of an oil pool as low as 10 to 15 per cent of the total in the ground and say that recovery is rarely more than 30 per cent. This low recovery, whatever the exact percentage, as well as all losses and wastes in production, storage and delivery, are problems that are now put up to the engineer. In short, the leaders of engineering thought in the oil industry are being given the real problems of oil conservation. That task is supplementary to the usual duties involved in ordinary engineering design and construction.

The chief engineer of one of the large California companies said recently that it would have been much better for the oil industry if civil engineering had never been split up into electrical, mechanical, mining and other branches. Service on the engineering staff of the large oil company is almost sure to include a wide variety of duties—oftimes quite foreign to those usually considered to be the field of the civil engineer. Versatility and adaptability are demanded rather than a high degree of specialization.

This is particularly true of the California fields where all the principal oil companies produce, refine and market their products. Their engineering departments may be called upon to design and construct small wooden dwellings or reservoirs with 15 acres of concrete lining; hydraulic problems cover the flow in pipe lines of fluids ranging from casing-head gasoline, considerably more mobile than water, to heavy, crude petroleum, more

sticky than molasses. It is necessary to design and install steam-, electric- and gas-power plants, find ways to combat corrosion in oil stills, pipe lines and tanks, program the operation of large fleets of motor trucks, and provide adequate fire protection for enormous quantities of stored oil.

With such a diversity of duties it might well be asked whether the civil engineer is better fitted for handling the engineering work than the mining, mechanical or electrical engineer. The large percentage of civil engineers among those who are doing engineering work in the California oil fields is certainly not due to any specific demand on the part of the oil companies for civil engineers. It seems, rather, a natural result of the civil engineer's training which helps him to adapt himself to work effectively in a variety of technical fields. He has simply met the requirements of the oil industry more frequently than the man trained in some other branch of engineering.

Engineering Department—Most of the oil companies have their construction work done by contract because of the large amount of equipment needed for rush work, but even so, maintain large engineering staffs.

While each oil company has its own plan of organization, the companies may be classified broadly as those who centralize and those who decentralize engineering responsibility. In the latter class authority and responsibility are placed together in each division of the organization and the headquarters engineering department co-ordinates similar activities in various departments and handles investigations of the problems common to several. Such an engineering department, besides getting out diagrams and plans or supplying consulting advice to other departments, gives attention to standardization of designs, fire protection activities, evaporation reduction, general corrosion investigation, etc.

Companies that centralize all engineering responsibility in a chief engineer, on the other hand, employ a resident engineer in each center field of activity who reports to the chief engineer. The Union Oil Co., whose organization chart is shown in the accompanying diagram, centralizes its engineering responsibility in this way and ordinarily has in the engineering department from 500 to 1,250 men, according to field conditions. Of this varying total usually 90 men are engaged in design.

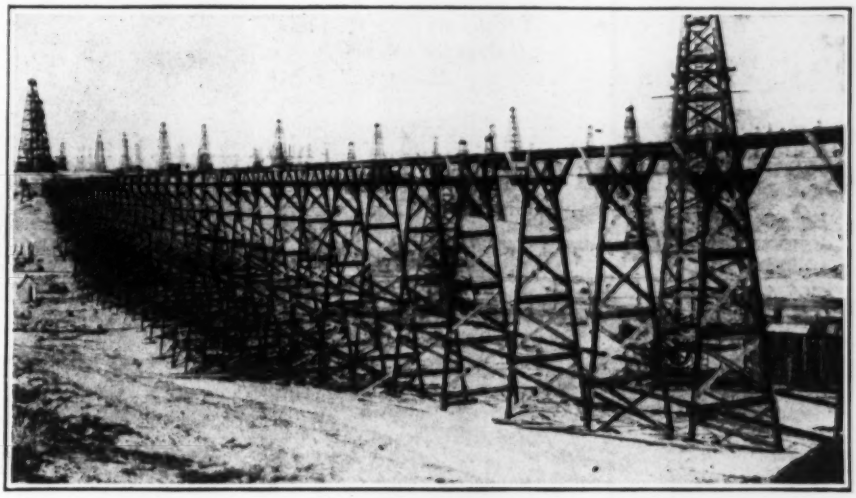


FIG. 2—AN OPEN METAL FLUME FOR COLLECTING OIL
Used in Kern fields to bring oil across a ravine delivering by gravity to storage tanks.

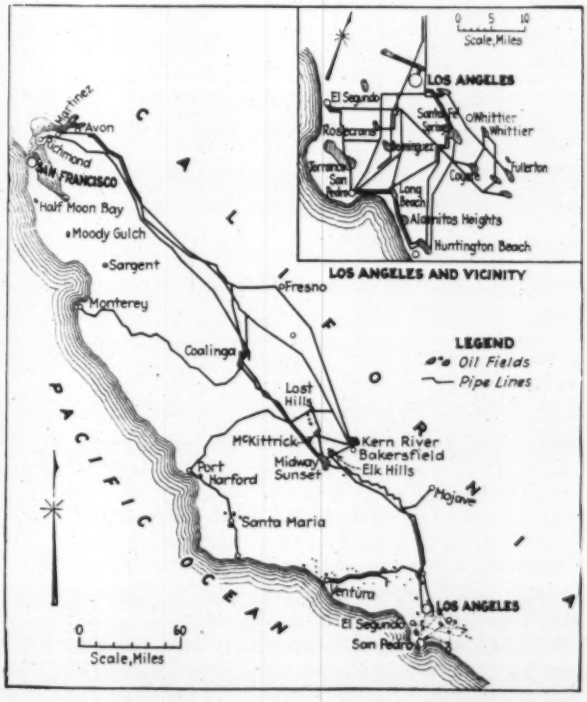


FIG. 1—OIL FIELDS AND OIL PIPE LINES OF CALIFORNIA

In the oil industry emergencies arise frequently and suddenly. The cause may be excess gas going to waste, an unexpected increase in production, the danger of losing an opportunity to get oil that otherwise would go to "the other fellow." Whatever the cause, when the emergency comes the cost of the work that is needed takes second place and speed becomes dictator.

In the Fullerton fields last year there was assembled in a period of five weeks a steam-driven compressor plant that can regularly and dependably deliver 8,500,000 cu.ft. of gas per 24 hr. at a pressure of 325 lb. per sq.in. No such speed could have been made if it had been necessary to order the equipment from eastern factories. The plant consists of a group of small units, made up of boilers of a type carried in local stocks, the whole layout of the plant purposely being such that everything required could be obtained locally and delivered by motor truck. Obviously not efficient on a long-term operating basis, the plant was nevertheless adequate because it was available in a minimum of time.

Some one has said that there are only two speeds under which construction work is done in the oil fields—"fast" and "faster." There is often a demand for speed even when no emergency exists. For example, having decided to put in a 12,000,000-cu.ft. compressor plant (nine 150-hp. engines) to supplement the production operations, one of the oil companies recently spent $250,000 in 90 days to get the plant ready as quickly as

possible. Because the decision to discontinue using such a plant may come as suddenly as the decision to build it, the usual plan is to write off the cost in 2½ years.

This high rate of amortization, which has been found to be a wise policy, has been reflected somewhat in the design. The building designed to house the plant just mentioned has nothing in the way of architectural treatment nor is the building material selected chiefly for its long service record. Concrete foundations and floor, timber frame, timber roof truss with steel bolts, sides and roof of galvanized iron, and metal window sash are the main items.

Producing Department—While the design and construction of oil well drilling equipment have been more or less standardized, the engineer in the producing department is expected to know what performance can be expected from mechanical equipment for developing power, compressing air, or pumping mud, oil and water. He must construct derricks for drilling wells up to 8,000 ft. deep, capable of lifting a 125-ton "string" of casing that may stick and require a pull of twice its weight. He must lay out collecting systems and pipe lines, build tanks, roads and camps, and he must do all these things better than the so-called "practical oil man" did them before the engineer came into the picture.

FIG. 5—"FISHING" EQUIPMENT BUT NOT FOR THE SPORTSMAN
Queer special tools used to fish broken drills, casings, etc., from oil wells.

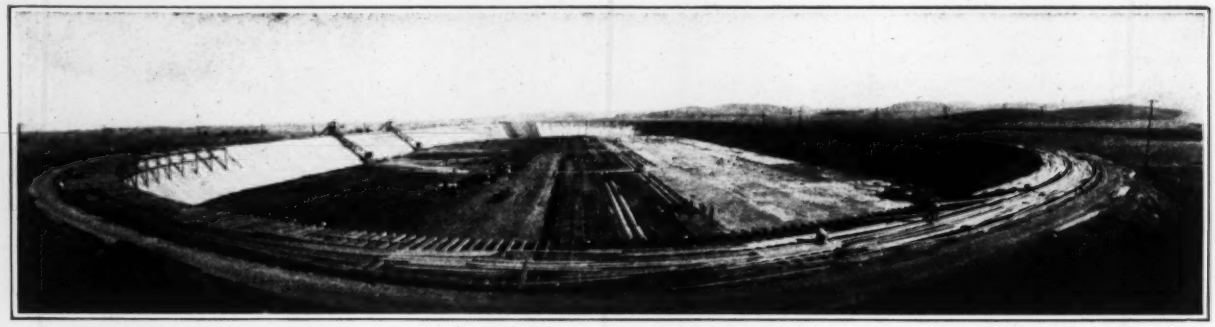


FIG. 4—CONSTRUCTION VIEW OF OIL STORAGE RESERVOIR
Operations under way include finishing earthwork, paving concrete floor, and starting timber roof construction. This is the 3-m. bbl. Los Medanos reservoir of the Standard Oil Co.

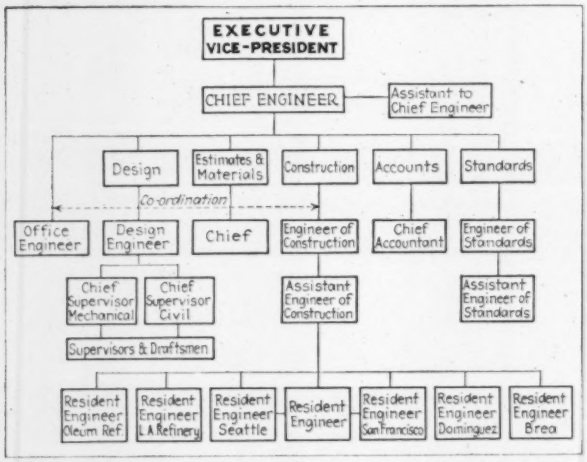


FIG. 3—ENGINEERING ORGANIZATION CHART, UNION OIL COMPANY OF CALIFORNIA

The large magnitude of operations in the producing department makes camp construction, water supply and sanitation important matters. With these usually go road building, land and topographical surveys and map studies, including delineation of geological data. Much of this is likely to be rush work, calling for high-pressure methods in design and layout.

Pipe Line Department—The organization charged with the construction of the long lines for delivery of oil from the producing department's stock tanks to refineries and tidewater is usually a department separate from the others. In southern California where the fields are for the most part near the coast, the transmission problems are simpler than in the San Joaquin Valley where large quantities of oil are pumped from the fields in the vicinity of Bakersfield some 280 miles to tidewater on San Francisco Bay.

In constructing pipe lines through unsettled country it is possible to use ditching machines and heavy construction equipment generally, while lines through thickly settled territory call for methods suited to the high property values involved.

Pumping conditions are similarly divergent; the heavy oils require heating, and the steam pumping stations, spaced on an average of 15 miles apart on the long lines, bring the oil up to a temperature such that it will arrive at the next station in a satisfactory fluid condition. Steam power is always used in these pumping stations in order that the steam may be available for heating as well as for pump operation. Three or more pumps, including a spare, are interconnected so that any one of two or more of them can serve an individual pipe line. The pumps are of the cross-compound,

flywheel, plunger type or some similar heavy-duty type, and operate at a pressure of 600 lb. per sq.in. A boiler installation rated at 1,000 b.hp. will adequately serve two of these pumps.

On the long transmission lines the pipe diameters range from 8 to 12 in. although the former is more common. The pipe is laid in the ground without insulation against heat loss, but is protected against corrosion by several wrappings of asphalt-impregnated felt and paper. Careful attention is given to the maintenance of these lines to guard against corrosion. Tests made by the U. S. Bureau of Standards rate soils in parts of the San Joaquin Valley as the most corrosive found in the United States. Based on inspection in the case of new lines or leakage and comparison where there are other lines nearby, the protective coating is completely renewed as often as is necessary to maintain adequate protection for the pipe metal. On this basis pipe line depreciation rates are kept down to a low figure, even in highly corrosive soils.

The very large oil reservoir is a distinctive factor in the oil-storage problem in California. Some fifteen or twenty years ago the reservoirs were made of comparatively small size, usually less than 500,000 bbl. This size standard has steadily increased and there are now in the state a considerable number of 1 to 2-m. bbl. reservoirs, several with a capacity of 3 m. bbl. and the Pan American Petroleum Co. has one at Watson that holds 4.3 m. bbl., said to be the largest in the world. At the El Segundo storage "farm" the Standard Oil Co. has 14 reservoirs whose capacity totals 21 m.bbl. These reservoirs are primarily for the storage of fuel oils and heavy crudes, although fairly light crudes are sometimes so stored. They are not used for gasoline or similar light products.

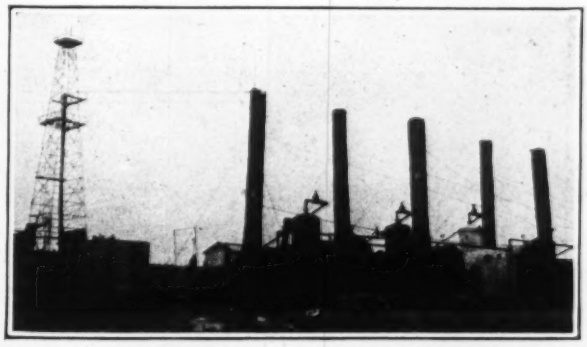


FIG. 6—TYPICAL POWER PLANT FOR OIL WELL DRILLING
Housing is omitted and only bare necessities are included in these field installations which are moved when drilling is finished.

These large reservoirs are generally circular or elliptical in plan, built in excavation and embankment. The slopes and bottom are thoroughly compacted, then lined with not over 5 in. of reinforced concrete. The roof consists of a timber frame covered with asphalt and gravel or some prepared roofing. To reduce fire hazard an inert gas is often put in between the oil surface and the roof. In such an event some extra care is taken in making airtight joints around doors and other openings into the gas space. The gas used is flue gas piped from some nearby boiler plant and the supply is maintained by means of blowers operating continuously to compensate for leakage or other losses. The gas is sucked through a water spray where it is cooled and cleaned. A group of relief valves, usually 24-in. aluminum disks, is set in the roof to release gas if the uplift pressure on the roof reaches as much as 4 or 5 oz. per sq.in. These valves often function during the heat of the day.

A typical oil reservoir with a capacity of 3 to 4 m.bbl. will have a concrete paved area of about 15 acres, a roof area of 14 acres and the tract of land required will be about 18 to 20 acres. The construction work will include 150,000 to 200,000 cu.yd. of excavation, about

FIG. 7—LAYING A TRANSMISSION PIPE LINE WITH SCREW JOINTS
From the extensive fields in the Bakersfield district pipe lines to tidewater on San Francisco Bay are about 250 miles long.

8,000 cu.yd. of concrete and the use of more than 1,500,000 ft.b.m. of lumber. It is now general practice to provide these large reservoirs with tall steel towers for lightning protection *(Engineering News-Record*, July 7, 1927 p. 4).

The total oil tank and reservoir capacity in California is now about 150 m.bbl. This storage is practically all filled and the same protest heard in other fields about overproduction is also general in California. Overproduction is ascribed to the operation of small tract owners, who rush their wells into production lest their neighbors drain the pool and thus, without any regard to the market, tax available storage capacities.

Refining Department—There is no basis for the idea that the civil engineer's activities at an oil refinery are over when its construction is finished. In California it is usual for each refiner to have an engineering staff. More often than not the chief engineer (in some companies called the resident engineer) and a considerable percentage of the staff are civil engineers. This staff is charged with the supervision of reconstruction and extension that is nearly always under way but when such work is not being done there is continual need for inspection and maintenance in the ordinary operation of the plant. In the small city of Richmond, for example, where the Standard Oil Co. operates a refinery with a capacity of 100,000 bbl. per day, part of the equipment is a salt water system designed to deliver 70 m.g.d. The maintenance and operation of this plant constitute one of the duties of the engineering staff. Also in large

plants experiments are often made on a full scale basis calling for the erection of large structures of brick and steel with unusual requirements as to pressures and temperatures.

Corrosion in oil stills, strictly a refinery problem, requires close attention and frequent inspection because of the serious result that would attend an accident. Containers used in distillation are operated under pressures up to 1,000 lb. per sq.in. or more and are made of steel

FIG. 8—A TYPICAL COMPRESSOR PLANT
Such plants may be written from books in 2½ yr.

in thicknesses up to 3 in. These "gunbarrel" containers are supplied by a few American firms and are also imported from the Krupp plant in Germany. The design and construction of supports and housing for large, heavy units of this character fall to the engineering staff at the refinery in those companies that do not centralize engineering work.

In California it is certainly not true that oil is found most often in out-of-the-way places. In fact, after combatting the difficulties that confront the production department in thickly settled territories, engineers often express a preference for the remote locations. The Santa Fé Springs field, for example, is in the heart of a fertile navel orange belt near Los Angeles. In such locations there are no difficulties of transportation but problems no less acute are substituted. Securing rights-of-way causes vexatious delays; utility lines require expensive protection; valuable property has to be protected against injury; the fire hazard is greatly increased and the automobiles of curious, idle throngs block the highways. In such locations the disposal of oil waste, and of mud or salt water pumped from the wells, and the provisions for fire protection assume the proportions of larger problems than they do in remote territory.

It is notable that although electric power is available in most of the oil fields there are but few completely electrified drilling outfits. A few that are in service in the Kern fields of the Standard Oil Co. use a 125-hp. motor for driving the drill rig and a 100-hp. motor for the mud pump. Firebox boilers are universally used in the oil fields for quick and temporary setups, usually in 50-hp. sizes and with a bank of 4 to 6 for each drill rig, according to kind of drilling, speed, etc. It has not been customary to house these boilers and they are often used without insulation. Return tubular boilers are used for more permanent installations and are, of course, provided with brick setting or other insulating material.

The standardization work done by various A.P.I. committees has been of very great benefit in the California oil fields, notably work on casing requirements, rig irons, tool joints, and steel derricks. In the latter, for example, 75 different derrick designs were cut down to 5 or 6 standard sizes that adequately serve all ordinary requirements and very greatly facilitate the manufacture, stocking and ordering of materials as well as erection and operation in the field.

Because steel plates come from eastern mills the standardization now under way on storage tanks is of particular importance to the California fields in reducing plate stocks. The large number of tank sizes heretofore used seems to be wholly unnecessary and it is believed that the number can be reduced to comparatively few. The engineering committees are intent on getting for these few a design that will give the best tank for the money. The first step was to standardize on a 6-ft. steel plate which is equally well adaptable to all the proposed standard tank sizes, besides being convenient to handle in erection.

Attention is given to stresses in the plates. Heretofore the stress near the bottom of each ring has been used in determining the suitable plate thickness. Tests with a very precise extensometer are being made in southern California on a 55,000-bbl. tank to ascertain just how these stresses vary as the tank is filled and emptied by stages. In this work, readings are being made to 0.0001 of an inch on the elongation, under stress, of that portion of the plate between a series of holes placed 10 in. apart circumferentially at different levels in the tank wall.

Several of the large oil companies have marine departments. The Standard Oil Co. of California, for example, operates 40 vessels of which 33 are ocean-going tankers. By experimenting with paints, the engineering department of one oil company has made improvements that have extended the period between dockings from 8 to 12 months with the same degree of protection against marine growth. Cleaning and painting tank cars is another duty that falls to this same engineering department and here, again, experiment with different types of protective coatings developed a paint that materially improved results.

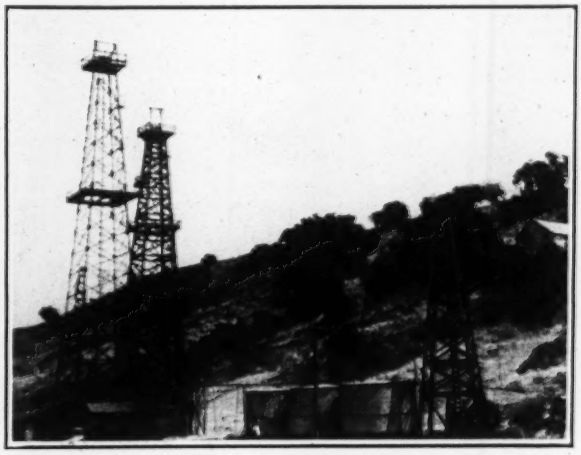


FIG. 9—THREE DERRICKS THAT REPRESENT PROGRESS IN TYPE AND METHODS
Derrick at right with cable tools drilled a 1,686-ft. well in 12 months, 1902-03. The center derrick with rotary tools in 1926 drilled a 2,580-ft. well in 8 months. The steel derrick with rotary tools drilled a 2,707-ft. well in 9 weeks.

A Series of Eight Articles on

Winter Construction Methods and Plant

BY C. S. HILL
Associate Editor, Engineering News-Record

1. Planning and Servicing Winter Construction
2. Winter Care and Servicing of Equipment
3. *Winter Excavation and Embankment Construction*
4. Concrete Road Construction in Winter
5. Winter Heating Concrete Materials and Mix
6. Handling and Placing Concrete in Winter
7. Protecting Winter Placed Concrete
8. Winter Inclosure in Building Construction

3. Winter Excavation and Embankment Construction

EXCAVATION and embankment construction in winter involve special methods, mainly in moving earth. Rock excavation, except as it requires winter protection of explosives and the general job servicing previously described, has no special problems. Frost is a positive obstacle to easy earth excavation and embankment construction to a degree depending upon the extent of freezing, the character of the operation, and the methods employed. These influences can best be appraised perhaps by discussing excavation and fill operations along functional lines.

Storing and Thawing Explosives—Low-freezing explosives are now made by most manufacturers. These ordinarily will not freeze at temperatures normally met in winter work, but with the mercury hovering around zero there is enough uncertainty to make it wise to house all explosives so that they cannot freeze. For this purpose, the manufacturers have planned and will furnish the plans of thaw houses, or rather warmed storehouses, of various capacities and kinds to meet any ordinary requirement. The manufacturers' handbooks describing this equipment and its operation and the best procedures of protecting explosives from frost are so generally available that the contractor is referred to them for detailed information.

Drilling and Blasting—Virtually all air tools including rock drills are made non-freezing so that, practically speaking, their operation in winter involves no procedures or precautions, except in connection with the air lines and receivers, which are unusual in summer. Methods of keeping air mains and receivers from freezing and of reheating compressed air were given in Article 1. In general, steam drills are not advisable for winter work chiefly because of the waste of power by condensation in the mains, and because of the hazard of freezing. Like drilling, in rock excavation, blasting with the modern types of explosives and modern methods of firing, calls for no special precautions or procedure in cold weather. Indeed, some kinds of rock appear to blast better in winter than when thawed.

Blasting, however, as a process of breaking up frozen ground, loosening materials frozen in cars, and removing ice jams or squeezes, has a specific winter technique. Generally, in breaking up frozen ground, blasting need not be resorted to except when the frost is deep; shallow frost crusts are readily handled by the power excavators commonly used. Isolated footing pits or trenches can be opened by thawing so that pick and shovel will meet the situation. In blasting frozen ground, holes can be formed by sledging a pointed bar or by air hammers with bull-point steels. Canadian contractors have found that using hot steels hastens materially the speed of drilling. Sizes and locations of charges will be determined by trial and observation.

In loosening material frozen in cars, the essential requirements are light charges and judgmatic spacing. Generally, quarter-stick charges scattered about with judgment in crowbar holes or crevices will loosen frozen gravel, sand, and broken stone with no damage to the car. Ice floes or gorges, where they endanger construction operations, can be effectually broken up by blasting. In many instances, exploding dynamite sticks in bundles scattered over the surface of a floe will break it up so that cakes will float away. In the case of gorges, a rather elaborate blasting operation may be required; it consists in breaking out a channel along the axis of the current from the downstream to the upstream edges of the dam by taking out a series of semicircular bites beginning at the downstream edge, as indicated by Fig. 8.

Thawing—Thawing in engineering construction as a means of breaking up frozen ground is in general limited to small yardage operations in narrow areas as footing pits or trenches. Generally, steam is the most practicable thawing agent, applied (1) through coils laid on the frozen surface, (2) by steam jet keeping warm water in the pit, and (3) by steam points melting their way into the frost crust. The third method is the most effective, and its technique for large operations has been highly developed in Alaskan gold mining where elaborate plants are employed. Those who wish to go into these plants and practices in detail may consult Technical Paper 309, and Bulletin 259, Bureau of Mines, Washington, D. C.

In ordinary construction operations no such depths of frost or such volumes and areas of material have to be thawed as in Alaskan mining, but some notation of methods of the most common practice of steam point thawing is instructive. The main steam lines are boxed in or covered to reduce condensation. The laterals end in headers to which several points are connected by hose; each header branch has a valve. The steam pressure is 100 to 150 lb. at the boiler. The points are $\frac{3}{4}$- or 1-in. extra-heavy hydraulic pipe. A tool steel bit is welded to the lower end of the pipe and has a $\frac{5}{16}$-in. hole for the steam to escape. A driving head is attached to the top. Generally a square or rounded taper bit is used. The points are spaced 4 to 10 ft. apart depending on depth and character of material. The materials to be thawed are muck, clay and gravel. Muck thaws slowly compared to gravel; clay thaws very slowly. Thawing costs from 10 to 30c. a cubic yard. Again, it is emphasized that the frost is very deep and that the volume and area of operations warrant elaborate thawing equipment.

Steam jets and warm water have been found advantageous in putting down footing pits for columns. As worked out on building construction near Chicago some years ago, the procedure was to turn the jet onto the ground over the footing space and shovel away the thawed soil until a pit had been started which would hold a little depth of water. Then the jet was left inserted in the little pond and periodically the thawed bottom was shoveled out; as the depth increased, the

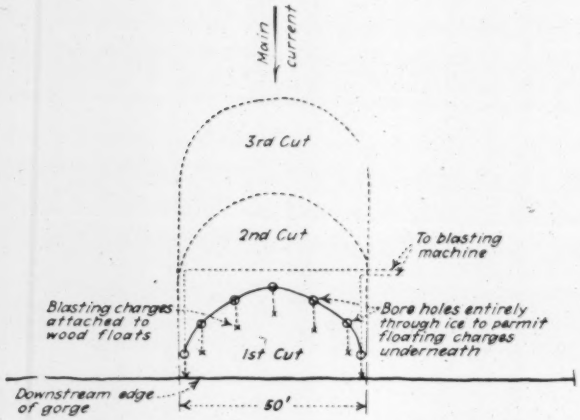


FIG. 8—DIAGRAM OF PROCEDURE IN BLASTING ICE GORGES

pit was curbed with the form boxes. By keeping jets going in a group of pits this procedure was quick and effective.

Thawing with steam pipe grills has been most effective for trench work. On sewer trenching near Toronto, Ontario, with about 3 ft. of frost, grids seven pipes wide and about 7 ft. long were laid end to end on the ground over the trench line, covered with 8 in. of manure and supplied with steam by a vertical boiler on a carriage. One-inch pipes were used spaced 1 ft. apart and enough grids were supplied to provide for 24 hours' thawing ahead of excavation. At the fastest, progress in trenching and pipelaying (45-in. concrete) was 50 ft. a day. On sewer work at Kalamazoo, Mich., the arrangement shown by Fig. 9 was employed. A 1-in. pipe was run along one edge of the proposed trench for 100 to 150 ft. turned across and returned along the other edge. To keep the pipe off the ground, it was laid on bricks at intervals and the whole was roofed over with segments of old sewer forms covered with 6 or 8 in. of sand. A boiler on a truck supplied steam. About 24 hours was

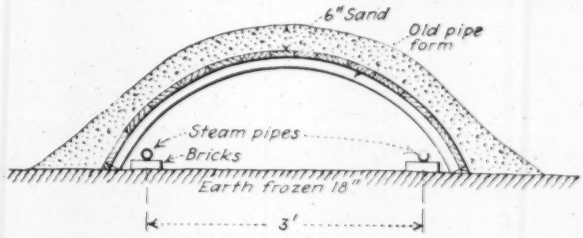


FIG. 9—METHOD OF THAWING FROST CRUST FOR TRENCHING

enough to thaw through up to 18 in. of crust; this was then excavated and the outfit moved ahead. A portable shelter was built around the boiler. Thawing a trench 36 in. wide cost 10 to 30c. a linear foot.

Steam coils in units about 18x20 ft. made up of 13 parallel $\frac{3}{4}$-in. pipe (260 lin.ft. aggregate) were used in groups of six to thaw ground for concrete floor slab in a building 300x380 ft. at New York. The frost was about 2 ft. deep. The coils were fastened to two 18-ft., 2x4-in. studs for handling, and when laid down for thawing they were covered with canvas laid on 2x3's 3 ft. apart, across which were other 2x3's and a second canvas cover.

Picking and Chiseling—Breaking up frozen earth by picking and chiseling calls for no further explanation than to direct attention to the possibilities of pneumatic tools compared with familiar hand methods. Any of the "pneumatic diggers" manufactured for digging hardpan and cemented gravel can be used with spade or chisel steels for breaking up frozen ground. They are particularly effective in breaking up thin crusts a foot or so deep, and in chiseling down frozen crusts at the top of pit or trench edges.

Protecting Excavation Bottom—Trenches and pits intended to receive footings require preservation from frost until the masonry is placed, and so generally does excavated earth emplacement for structure of any sort. No foundation should be placed on frozen soil. Pit and trench sides ordinarily may safely be allowed to freeze if thawing will naturally occur before the backfilling is placed. Putting in backfilling against frozen sides is not well and particularly it should not be put in on top of ice and snow frozen in the bottom between wall and trench side. Keeping frost out of the excavated foundation bed until the masonry is placed is, however, the paramount requirement. Generally, a covering of straw or manure will protect the bottom if there is no water, or the excavation can be covered and kept warm by oil or other heaters. Ice and frozen snow on foundation beds are as bad as frost in the ground and should as religiously be prevented or removed. Where large areas are to receive slab or mat foundations, blanketing with straw or manure will prevent freezing for the usual perioc necessary. Straw covered with canvas has been very successful in protecting road subgrade as will be described in Article 4. In general, a rule for contractors in preparing to build on earth foundation beds in winter is: Prevent frost or, if this cannot be done, find frost and remove it.

Winter Filling—Frost is an obstacle in placing fill: the material freezes in the cars, frozen material is harder to spread, frozen tracks are harder to shift, and frozen material in the fill prevents settlement until thawing occurs. In general, fills to be built upon or to impound water can be made in winter only with many precautions, unless they are to stand before use long enough for thorough thawing and final settlement. Embankment construction in spread and rolled layers virtually demands unfrozen material. Dumped embankment can be built of earth containing frozen chunks, but it has to thaw out before attaining settlement and position.

Ordinarily, hydraulic fill in winter is held impracticable. In dam building in Michigan in 1918, however, some 300,000 cu.yd. were placed between October and April with average monthly temperatures of 5 to 35 deg.

Most of the earth was obtained from a high bluff near one end of the dam, being transported to place in the earth embankment by means of sluicing troughs carried on wooden trestles. These sluicing troughs were for the most part made from No. 10 gage steel plates, and were approximately semicircular in shape, with a diameter of 30 in. The troughs were 10 ft. long, and were so placed on the trestle that they overlapped each other a few inches. The sluicing grade was from 6 to 8 per cent, and in ordinary weather no trouble from leakage was noted. However, in extremely cold weather it was found that there was a tendency for the slight back leakage through the joints between the troughs to form ice which gradually built up, lifting the lower end of each

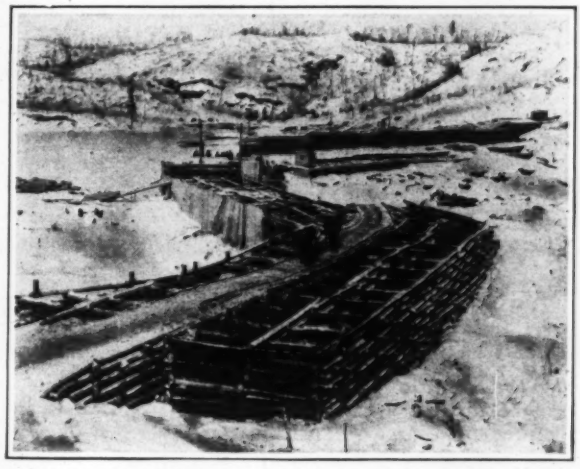


FIG. 10—COFFERDAM CONSTRUCTED ACROSS FROZEN QUEBEC RIVER

trough so that the effective sluicing grade was materially flattened. Frequent removal of ice at joints was necessary.

Centrifugal sluicing pumps were utilized, all of them being motor-driven. All the pumps were housed in, and no especial trouble from freezing was encountered on account of the very cold weather. As long as the water was kept in motion through the sluicing pipes, there was not much delay from freezing, but if for any reason the flow was stopped, it became necessary to thaw the pipes. The construction organization became so proficient in the use of the plant, however, that comparatively little delay was caused during the winter on account of freezing of the water supply. Constant attention was required to keep the ice removed from the sluicing troughs but it was found that little ice was deposited in the embankment and there was no tendency for the sluiced fill to freeze so long as water was allowed to run over the surface.

When the temperature remained below 15 deg. for more than a few hours, sluicing was stopped. The embankment surfaces under construction were cleared of snow and ice when starting anew. In some cases, where it was not possible to make a continuous fill, the ground froze, and it became necessary to utilize steam jets for

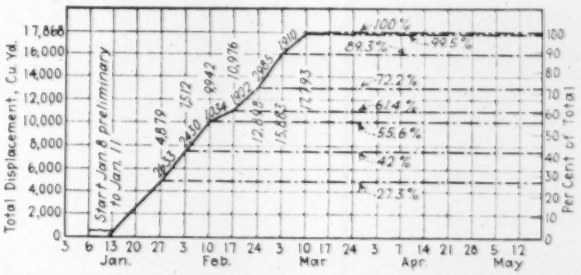


FIG. 11—PERFORMANCE CHART OF WINTER COFFERDAM CONSTRUCTION

thawing the frozen material before sluicing was resumed in that particular location. These steam jets gave very satisfactory results, and it was found possible to thaw a large area by one pipe left in place several hours.

Drainage—Drainage of pits and trenches often presents a troublesome problem in winter. On occasion when water comes from general light seepage frost may be a decided advantage in sealing the ground with ice. Where considerable flow from springs or veins requires ditching, sumps and pumping, the problem becomes one of keeping ditches open and pump suctions and discharges clear of ice. If the ditch is one which will be permanent during the operation, freezing can often be prevented by digging it deep, carrying a good depth of water, and roofing it with boards and dirt, or allowing an ice crust to form, under which the water can flow. A good current is a great preventive of ice formation and measures to keep up a steady flow by pumping or ample fall in the ditches, should be employed. A steam jet in the sump, suction and discharge pipes boxed in as described in article 2, and heated pump housings are other cold weather precautions. The conditions and requirements of excavation pit drainage in winter are so various that judgment must always determine the means. It is entirely practicable in some operations to let water and frost have their way and do no constructive drainage until warm weather loosens the ice, and the water has free flow. Again, the conditions and requirements may be such that immediate and continuous removal of the water is necessary. Then drainage works are necessary, and all the precautions which are needed to keep them free from freezing have to be employed. In ground soft with water, but giving off no considerable volume of water, freezing may be a decided help to excavating operations by solidifying the pit floor.

Putting Ice to Service—Ice may be a help as well as a hazard in construction. Its value in solidifying soft ground and marsh and in sealing up seepage in excavation has been mentioned; here it is considered in its utility as a means of working from the surface of streams and lakes. Its use as a means for making soundings, borings, gagings and other bottom and flow surveys will occur to all. It is a decided aid often in cofferdam con-

struction. In building the Isle Maligne dam on the upper Saguenay in northern Quebec, the frozen river was utilized in cofferdam construction as shown by Fig. 10, and the chart, Fig. 11. Other reasons than the service that a frozen stream could render dictated cofferdam building in winter and the ice aid was only incidental, but the circumstance illustrates a possibility. A condition here, peculiar only to far northern swift streams, was frazil ice. To carry the ice bridge across mid-channel, where the current prevented freezing, brush booms were carried across. These gave a slight check to the current and also a collecting place for ice, with the result that the frazil ice congealed and built up an ice closure across mid-channel. Important preparatory work of many kinds can be performed by means of the ice bridge such as swinging across-stream cableways, cable footbridges, and trestles, or as putting equipment across stream for spring excavating operations. Canadian constructors have developed a keen wit in utilizing ice on streams for doing many things; its possibilities should not be disregarded in planning winter construction.

Foundation Work Hampered by Soft Ground and Seamy Rock

Sulphur-water and Gas, Injurious to Concrete, Shut Off by Grouting—Shaft Lining Jacked Down in Soft Clay

By C. H. Dickinson

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IN SINKING caissons or wells for concrete foundation columns at the new Delray No. 3 power station of the Detroit Edison Co., now under construction, some difficulty was encountered when bedrock was reached. One of the wells is shown in Fig. 2. This bed, which is about 76 ft. below the mean level of the Detroit River, is a rock of limestone character, but not a true limestone since the lime content is only about 10 per cent. The difficulty was due to the flow of water containing sulphur compounds in this rock.

Grouting Seamy Rock—Since ordinary concrete is injured by contact with such water, it was realized that the flow through the foundation area must be stopped definitely if the concrete were to endure. When the water was first encountered, tests were made to determine whether or not the whole area was seamed with it. These tests were made by sinking several 6-in. casings into bedrock at various points in the area. Air pressure was then applied to the test casings and the continuity of the seams was proved when the air came bubbling up in caissons at a considerable distance from the test holes. That the water in the rock was alive and flowing at an appreciable pressure was demonstrated by the fact that in one caisson the water rose to a height of 10 ft. above the river level. Concentrations in the sulphur-water are not particularly high, though high enough to be taken seriously. Analysis shows that the water contains in parts per million by weight:

Sodium chloride	2,130
Sodium sulphate	662
Magnesium sulphate	178
Calcium sulphate	1,402
Calcium bicarbonate	467
Sodium hydrosulphide	67
Iron oxide and silicon	Traces

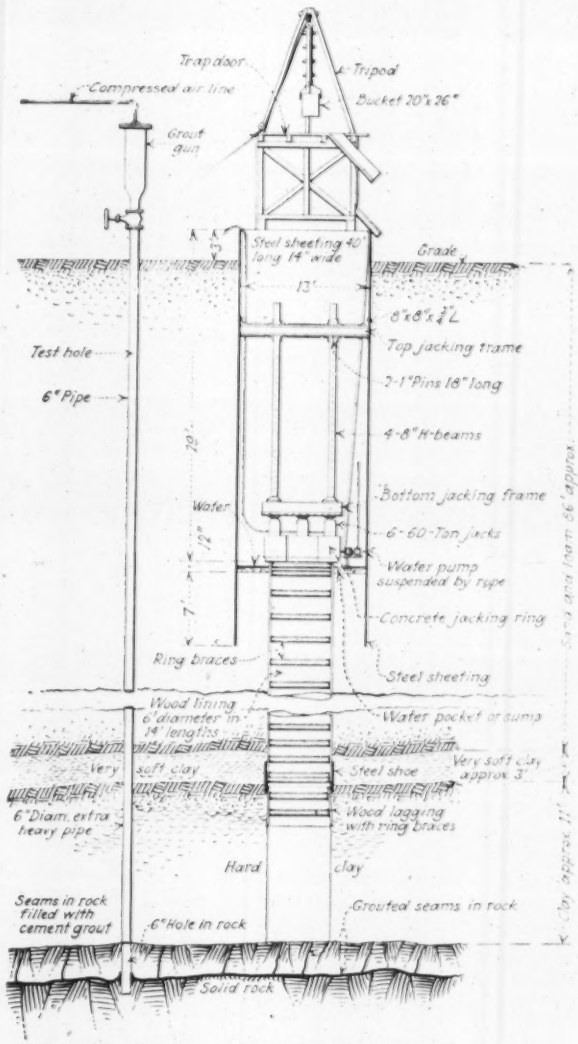


FIG. 1—JACKING WOOD LINING FOR 6-FT. SHAFT

Although the foundation columns were not designed to enter the bedrock, but only to rest upon it, and were therefore above the normal level of flow of the sulphur-water, it was felt that this water should beshrdaul entirely from the foundation area to such a depth as to remove any possibility of deterioration of the concrete. To this end, 6-in. casings, similar to the test holes, were sunk throughout the area in the centers of the bays formed by the caissons and at comparable spacings around the outside of the area. A cement gun about 10 ft. long and 10 in. in diameter, shown in Fig. 1, was made of iron pipe with caps arranged so that the lower end could be screwed on the 6-in. casings and air pressure introduced at the top. The gun was filled with a fairly liquid grout made up of cement and "pumicite" in the proportion of 19 bags of the first to 8 bags of the second. To force the grout into the seams of the rock, the air pressure averaged 80 lb., with a maximum of 110 lb. The grout holes enter the rock to a depth of about 4 ft. and there is every assurance that the foundation columns are safe from attack by the water.

By the grouting method it has been possible to exclude the sulphur-water completely from the holes and to secure a concreting condition under which a rich, carefully prepared concrete, mixed with particular attention to low water content, could be placed ideally in the open

excavation. Extensive chemical investigation showed that with the sulphur-water excluded from the hole, and with the hole completely filled with high-grade concrete, the impervious nature of the clay would practically eliminate exposure of the pier to the sulphur-water even though the grout in the rock seams should fail to provide a permanent seal.

Previous to this Delray job, as far as the writer is aware, there have been no foundations carried to rock in the city of Detroit. Previous attempts at deep wells or caissons have led to the belief among engineers here that there was danger of sulphur gas being encountered at the upper rock surface, and that pneumatic methods with air locks, while effective for excluding water, would not be effective for excluding gas. Lives have heretofore been lost in such attempts and, while the information available is hazy, there has been a common belief that these lives were lost due to an inflow of gas. All of this has somewhat discredited the air-lock method and for this reason it is felt that the grouting method is particularly suitable for this locality. As a demonstration of the feasibility of going to rock by the grouting method, since the opening of the Delray job two important structures in the downtown district have adopted this procedure.

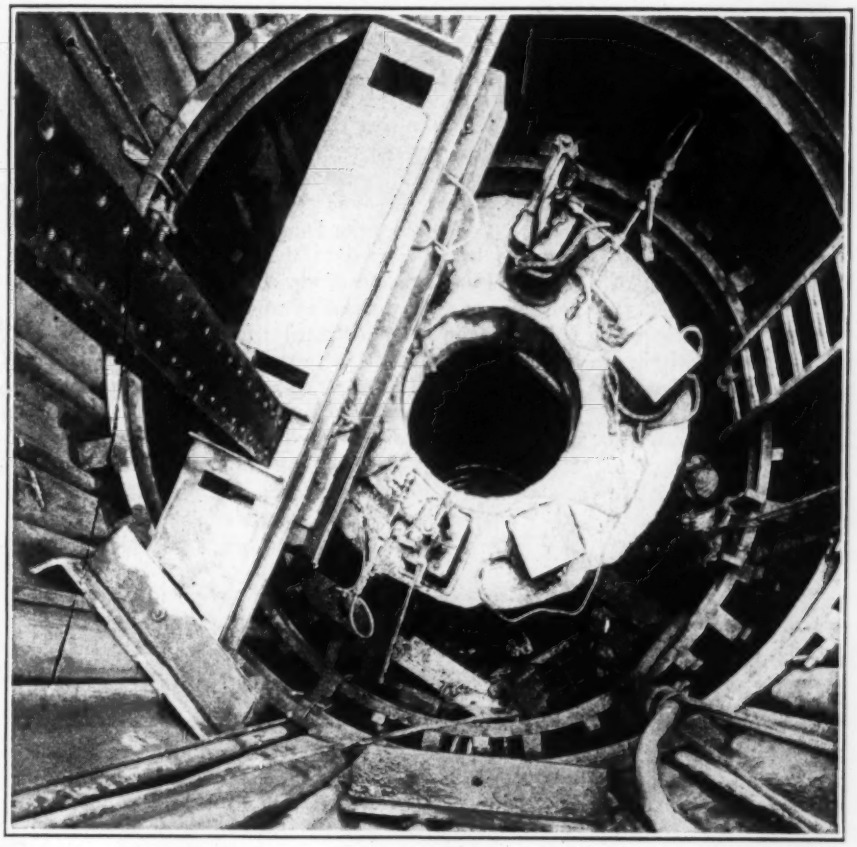


FIG. 2—FOUNDATION SHAFT WITH JACKING RIG

Part of frame removed, showing jacks on concrete ring at head of 6-ft. shaft. Top of shaft 11 ft. 3 in. diameter inside steel sheeting. One of the four jacking posts is shown at the left.

Jacking Shaft Lining—Sinking the shafts or caissons for the foundation piers of this Delray power station is done by open-well excavation through about 86 ft. of soft clay, followed by a 3-ft. layer of very soft sandy clay and then 11 ft. of stiff clay to bedrock. For about 33 ft. the shaft or well is 11 ft. 3 in. in diameter, lined with interlocking steel sheeting in 40-ft. lengths, as shown in Figs. 1 and 2. Below this is the 6-ft. well extending to rock and to be filled with concrete to form a foundation pier.

In this soft ground, the shaft could not be excavated in lifts in advance of the vertical lagging, but it was necessary to force the lagging down by jacks, adding top lengths as the work progressed. This lagging is of 3x6-in. tongued-and-grooved pine, made up into cylinders 14 ft. long, held to shape by interior ring braces of 6-in. channels. There are seven and nine rings to each length in the upper and lower parts of the shaft respectively.

These cylinders were built up complete on the outside and then lowered into place. To carry this lining down through the clay, a steel shoe is used, 6½ ft. in diameter and 2½ ft. high, built up of ⅜-in. plate and having a ring brace of a 10-in. channel placed 2 in. above the cutting edge. The large diameter inside the steel pile sheeting at the top of the shaft is necessary to provide for the jacking apparatus.

On the head of a 14-ft. cylinder of 6-ft. lining, as lowered into place in the enlarged top of the shaft, is a 4-in. oak cover, having a 6-in. channel forming a ring on the underside, to fit inside the lining. Upon this cover rests a reinforced-concrete ring, 7½ ft. in diameter, 24 in. deep and 27 in. wide. Six 60-ton hydraulic jacks of 18-in. lift are seated upon this ring and bear against a jacking frame of timbers 14x15 in., with a 15-in. channel on the bottom. Four 8-in. H-beams 15 ft. long seated on this frame, pass through guides in an upper jacking frame composed of 12-in. and 10-in. channels welded together.

At the top, this frame butts against a ring of 8x8x¾-in. angle welded to the steel sheeting and taking the upward pressure of the jacks. Holes 1¼ in. in diameter and 6 in. apart are formed in the flanges of the H-beams to receive 1⅛-in. pins 18 in. long. For each 16-in. stroke of the jacks, the pressure is released while the pins are being shifted. There are two pins to each H-beam.

The lining cylinders could not be jacked into the stiff clay or hardpan which obtains for the last 12 ft. above the rock. Here the hole or shaft was cut out ahead and the cylinder then jacked down far enough to seal off sand and water.

This Delray work is being executed by the construction bureau of the Detroit Edison Co.; A. S. Douglas is construction engineer, and the writer is superintendent of construction.

Missouri River Highway Bridges in North Dakota

State Opens Two New River Crossings—Pneumatic and Open-Dredged Caissons—Pier Design and Truss Spans

By CLIFFORD JOHNSON
Bridge Engineer, North Dakota Department of State Highways, Bismarck, N. D.

WITH the construction, during the past year, of two bridges across the Missouri River at Sanish and near Williston, North Dakota has completed two important links in its state highway system and has connected this system with McKenzie County, the largest in the state, which heretofore has been practically surrounded by rivers. Previously, the only state highway bridge over the Missouri was the one between Bismarck and Mandan, built in 1920-1922. In 1925, the legislature made appropriations which, together with federal aid and some county money, made possible the construction of both bridges at once.

Williston Bridge—The only feasible location within a reasonable distance of Williston, from the standpoints of highway connection, foundations, and stability of river channel, was about six miles above the city. The north bank is a high bluff of firm yellow clay with some gravel. On the south side is a low flat bottom of fine sand and silt, about 3½ miles wide. The river bed is a fine sand, invariably found in this section of the Missouri. Beneath the sand is a hard and tough blue clay, highly resistant to the action of water and of good bearing power. The depth to this clay varies from practically nothing at the north edge of the channel to 86 ft. below average low water at the opposite edge.

On this section of the river the War Department requires a vertical clearance of at least 38 ft. above the high-water elevation of the navigation season, but it approved the State Highway Department's plans for maintaining this clearance under the two north spans only. This made it possible to build the bridge on a grade, with its north end at the top of the bluff, while the south end would just clear the extreme high-water elevation. A considerable saving in cost was thus effected, for with 38-ft. clearance under all the main spans, a high trestle and heavy earth fill would have been necessary to bring the roadway down to the low bottom lands on the south side.

Superstructure—Over all, the bridge is 1,438 ft. 1 in. long, measured horizontally. The width of roadway is 22 ft. clear between trusses and 20 ft. 8 in. inside of curbs. The superstructure consists of four truss spans 315 ft. long between end pins, and three plate-girder approach spans totaling 168 ft. on the north end. No approach spans are required at the south end, the truss span being seated about 65 ft. back from the edge of the bank so that it could be supported on a rather light, shallow pier on piling, instead of a heavy, deep pier which would have been necessary at the edge of the channel. On the approach spans and the first two truss spans from the north end there is a grade of 2.52 per cent; on the third and fourth truss spans the grade is 3.47 per cent, making a total difference in elevation of 42.24 ft. between the ends of the bridge. The reinforced-concrete floor slab, 7½ in. thick on the approach spans and 7 in. on the main spans, has a 2-in. wearing surface of asphaltic concrete.

For the three approach spans the girders are 40, 70 and 55 ft. long, consecutively. Each span consists of four deck plate-girders with the floor slab resting directly upon them, no floorbeams being used. This construction was found to be simpler and lighter than with two heavier girders and transverse floorbeams. The 70-ft. girder span crosses the Great Northern Ry. tracks and provides clearance for four tracks, although there is only one at present.

The truss spans are all alike and of the extensively used Pennsylvania type with sub-struts. Top chords and end posts have two web plates and four angles (turned out), with a cover plate on top and double lacing on the bottom. The bottom chords have two web plates and four angles (turned out), with tie plates on both top and bottom; the main diagonals and hangers, four angles with tie plates; the main posts two channels with single lacing on each side, the flanges (not the backs) of the channels being riveted to the gusset plate. The sub-diagonals and bracing struts consist of two small channels with flanges turned in and laced, the top laterals (both diagonals and struts) of two angles laced, the bottom laterals of a single angle or two angles back to back as required. Interior sway bracing is made up of two angles (turned in) with tie plates, and the portals of two angles (turned in) with lacing for the stressed members and tie plates for the redundant members. Plate-girder sections were used for the floorbeams, and standard I-beams for the stringers. These trusses were shop-assembled to the proper camber and all main field connections were reamed.

Substructure—A shallow box-type abutment (8 ft. from bridge seat to bottom of footing) and two piers 34 ft. and 32 ft. high are required for the north approach. Each pier is made up of two rectangular columns resting on individual spread footings, the columns being connected by cross beams at the top and about one-third up from the bottom. All these footings are in firm yellow clay, well above the elevation of extreme high water.

The main shore pier on the north side is 80 ft. high and consists of two cylindrical columns resting on individual spread footings 14 ft. below low water in firm blue clay. The columns are connected by heavy cross beams at the top and at the ground line, 32 ft. from the bottom of the footings.

As previously noted, the south shore pier or abutment is supported on timber piles cut off just below extreme low water level. These piles have a penetration of from 35 to 38 ft. in the sand and developed an average bearing power of about 35 tons each. The pier is made up of two rectangular columns resting on individual footings, and connected by a heavy beam below the bridge seat. Above this bridge seat is a backwall to retain the earth fill. A short wing, parallel to the center line of the roadway, is cantilevered back from the outside edge of each column. The columns are placed eccentrically on their footings so that the overturning moment of the earth fill is balanced by weight of pier and span.

For 400 ft. in front of this pier there is revetment to protect the bank. More revetment will no doubt be needed in the future, to protect the pier and approach and for the maintenance of the navigable channel. The action of the current and shifting of the channel in the

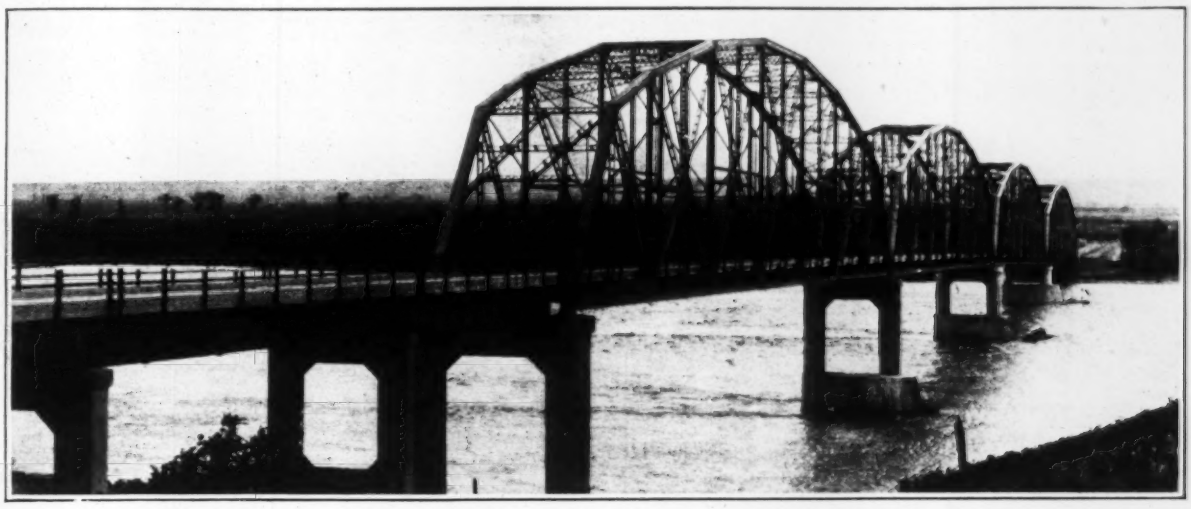


FIG. 1—MISSOURI RIVER BRIDGE, WILLISTON, N. D.

first five miles above the bridge are being regularly watched and studied so that protective work, when it becomes necessary, can be undertaken in time.

On this section of the Missouri the ice action is very severe, on account of the thickness of the ice and the velocity of the current. The variation in the river stage is greater than elsewhere, being 30 ft. between extreme low and extreme high water level; extreme high stages are caused by ice gorges. For these reasons it was decided to make the river piers solid and massive.

Each river pier consists of four main sections: (1) The caisson; (2) the crib or shaft; (3) the pier block, extending from below extreme low water to above extreme high water; and (4) two cylindrical columns 7 ft. in diameter, extending from the top of the block to the bridge seat and connected by a beam at the top. The caissons were designed originally to be sunk by the open dredging process, but the contractor preferred pneumatic sinking. They are of the type and design developed by E. H. Connor, vice-president and chief engineer of the Missouri Valley Bridge & Iron Co.

For pier 2, the caisson is 18x50 ft. and was sealed 48 ft. below low water. It was sunk 15 ft. into the firm material underlying the river sand, on account of the shallow depth of sand at this point and the probability of its being scoured out so as to expose the surface of the clay. The crib is 12x46 ft. For piers 3 and 4, the caissons are 20x61½ ft., sealed 71.5 ft. and 73 ft. below low water, respectively. The original plan called for sinking them 12 ft. into the firm blue clay, but this was reduced to 6 ft. when the actual character of the clay was revealed by excavation. In sinking these caissons considerable difficulty was caused by boulders and large granite slabs and some ledge rock just overlying the clay. The cribs for these piers are 12x56 ft. The pier blocks are all alike, 9x37 ft. at the bottom, with a batter of 3 in. per foot on the ice nose. Two arcs, tangent to the sides of the block and to the sides of a 90-deg. angle at their intersection, make up the plan of the pier nose. The downstream end of the block is semicircular.

Sanish Bridge—A satisfactory site for this structure was found directly opposite the town, where the bluff on the east bank forms a good approach. Foundation conditions were much more favorable than at Williston, as the depth to the tough blue clay is practically uniform across the river and is only 20 to 28 ft. below low water.

This bridge is 1,159 ft. long. Its superstructure is four 273-ft. truss spans and one 55-ft. deck plate-girder approach span. The second main span from the east end is level and at the clearance required by the War Department. From this the other spans slope downward, at 2.19 per cent to the east and 4 per cent to the west. Some consideration was given to a scheme for eliminating the sharp breaks in the grade by making the elevations of the tops of the piers and the camber of the spans such that the bottom chords would be on a uniform curve from one end of the bridge to the other. This would have improved the appearance, but as the vertical curve would make the grade steeper at each end, it was decided that the breaks between the different uniform grades would be less objectionable.

Trusses and girders, the roadway, approach abutment, shore piers and channel piers are mainly the same as for the Williston bridge. The trusses, however, were not shop-assembled for reaming, but all main field connections were reamed to templets. The joints matched almost perfectly and the spans fitted up with the camber for which they had been figured.

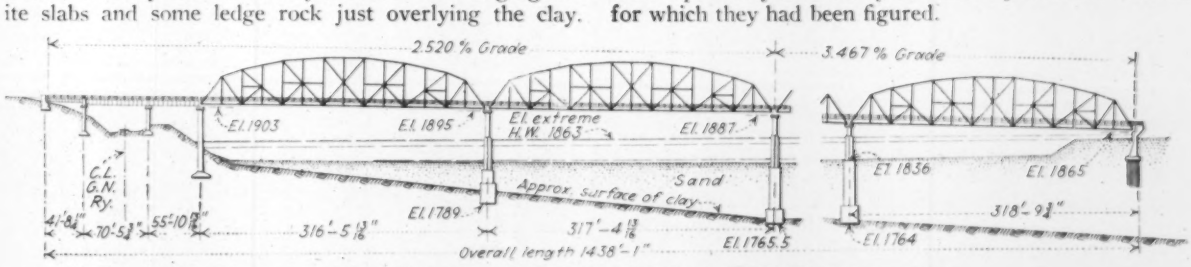


FIG. 2—SPANS AND FOUNDATION CONDITIONS AT WILLISTON BRIDGE

Pier Caissons—For the river piers at Sanish, reinforced-concrete caissons were sunk by open dredging. Each caisson is 17x51 ft. at bottom, with octagonal ends. In the second 6 ft. up from the bottom, a 30-in. offset all around makes the shaft 12x46 ft. To counteract the strong tendency which bell-bottomed caissons have to list during sinking, a wall of timber was built all around, flush with the outside of the cutting edge and securely braced against and tied to the caisson shaft. The space between the outer sheathing and the shaft was filled with sand and clay from the excavation to balance some of the inward pressure on the timber and to provide dead weight for sinking. Three dredging wells, 7x9 ft., extend down through the shaft and flare out to include the whole area of the base at the bottom.

FIG. 3—MISSOURI RIVER BRIDGE, SANISH, N. D.
Note grade of roadway on the spans.

On account of the comparatively shallow depth of the overlying sand, all three of these caissons were sunk 15 ft. into the firm blue clay as a precaution against scour. The caisson for the middle pier was sealed 40 ft. and the others 38 ft. below low water. Each caisson was unwatered as soon as the cutting edge had penetrated the clay and excavated and sealed in the dry.

Engineers and Contractors—The Williston bridge was built complete under one contract awarded to the Missouri Valley Bridge & Iron Co., Leavenworth, Kan., on April 22, 1926. It was completed on June 10, 1927, and dedicated on July 1 as the Lewis-and-Clark Bridge. The original contract price was $586,889 and the final estimate $571,863. M. L. Wagner was superintendent for the contractor. R. M. Van Petten was resident engineer for the State Highway Department, but met with an accident in the early stages of the work. Ernest J. Budge was then in charge for two months, after which Clinton A. Haskin was resident engineer until the project was completed.

For the Sanish bridge, a contract for the complete structure was awarded April 22, 1926, to the Minneapolis Bridge Co., which completed it on June 28, 1927. The original contract price was $422,290 and the final estimate $425,553. Isak Helseth was superintendent for the contractor. L. M. Brumfield was resident engineer for the State Highway Department, with P. M. Hegdal in charge of materials. This bridge is to be known as the Verendrye Bridge.

Preliminary surveys for the two bridges were made by engineers of the State Highway Department in the summer of 1925, the E. J. Longyear Exploration Co. of Minneapolis being employed to make test borings. Both bridge projects were engineered entirely by the State Highway Department staff; H. C. Frahm, chief engineer; C. A. Myhre, assistant chief engineer, and the writer as bridge engineer.

Railway Track-Recording Car Uses Gyroscope

Novel Equipment on Santa Fe Ry. Car Increases Accuracy of Automatic Records of Track Conditions

ADAPTATION of the gyroscope to automatic measurement and recording of railway track conditions is a special feature of the latest track-recording car, which has been put in service by the Atchison, Topeka & Santa Fe Ry. as an adjunct to its maintenance-of-way work. Such a car records in chart form the condition of track as to gage, low joints, curve elevation and other characteristics. The following description of the new car and its equipment is condensed from a paper prepared for the committee on Track, of the American Railway Engineering Association, by J. de N. Macomb, office engineer (now resigned), and E. E. Chapman, engineer of tests.

Records—The mechanisms on this car record the following information: (1) Low joints for each rail; (2) track gage; (3) lateral movement of truck and car body in relation to right-hand rail; (4) car body inclination and cross level of track; (5) time intervals (from which speed may be determined); (6) location of landmarks. All this information is recorded by pens on paper passing over a platen or table.

Low-Joint Mechanism—In the six-wheel truck, Fig. 2, the front and rear axles are connected by a rigid and heavy bar. These axles are 10½ ft. c. to c., and the drop of the center wheel below the common level of the outer wheels is recorded by means of the contactor box shown at the middle of the bar. In this box are a series of contact plates electrically connected to recording pens. A contactor in the form of a steel roller, connected in the opposite side of the electric circuit and attached to the journal box of the center pair of wheels, rolls over the contact plates as the wheel drops into the low spot or joint.

When the center wheel drops ¼ in. below the outer wheels, the roller touches the first contact and an electric circuit energizes a pair of electro-magnets which operate one of the pens on the record desk. The pen moves laterally, indicating a joint ¼ in.

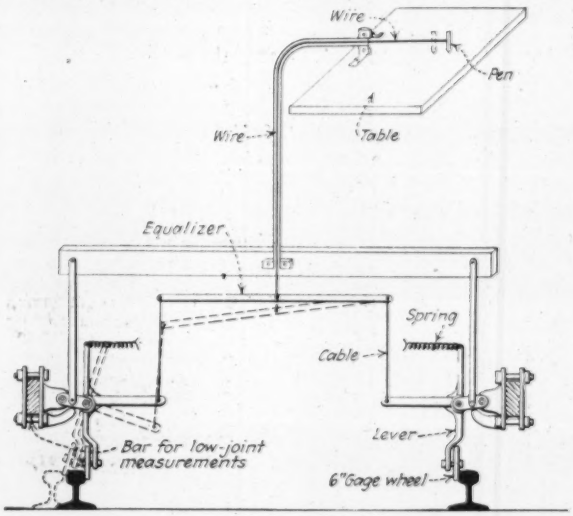


FIG. 1—MECHANISM FOR GAGE OF TRACK

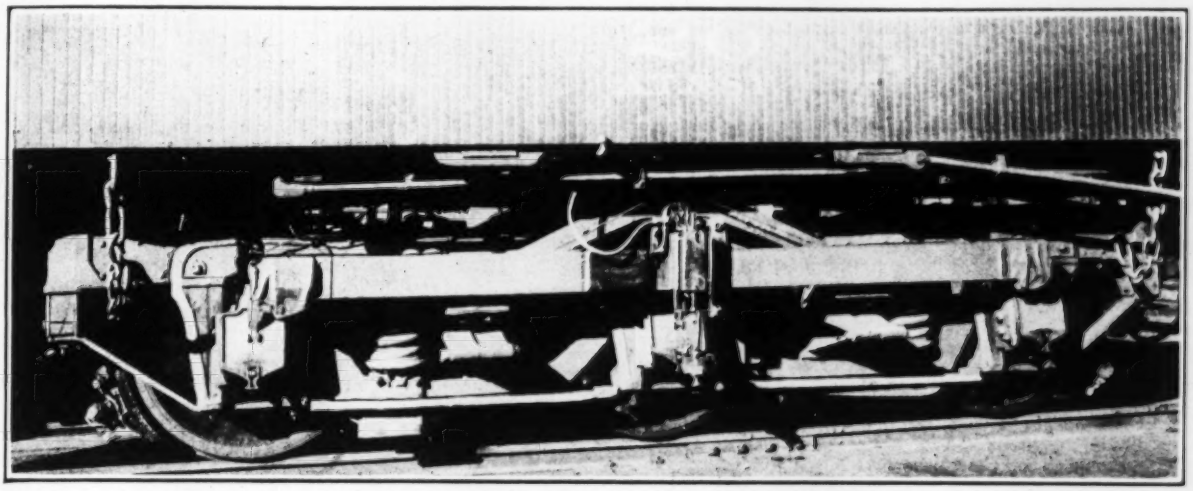


FIG. 2—TRUCK OF TRACK-RECORDING CAR; SANTA FE RY.

low. If the wheel drops ¼ in. or ⅜ in., the roller is pulled down farther and touches a second or third plate, closing other electric circuits and moving other pens on the recording desk.

Such a mechanism is mounted on each side of the truck and there is a separate set of three pens on the recording desk for each rail. On main line track, measurements of ¼, ⅜ and ⅜ in. give satisfactory results. On branch-line track, measurements of ¼, ½ and ¾ in. appear to be satisfactory. The current which energizes the electro-magnets operating the pens also passes through corresponding electro-magnets which actuate mechanical counters. Thus whenever a mark is made by any one pen, an additional digit is shown on the corresponding counter, which thus shows the total number of joints indicated by each individual pen over a certain territory.

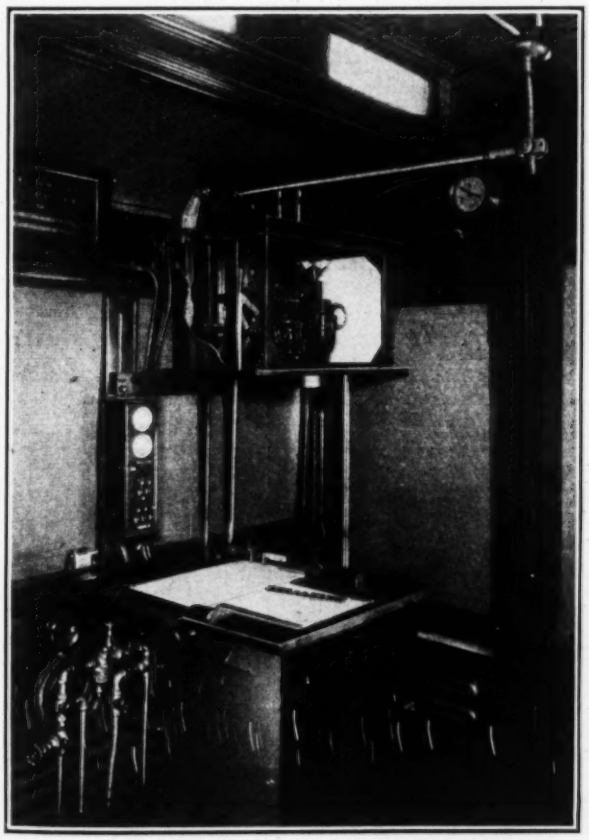


FIG. 3—GYROSCOPE MOUNTED IN CAR
The gyroscope is in the glass cabinet over the table on which the paper chart travels.

Track Gage Mechanism—For continuous record of gage of track, two 6-in. wheels held outward against the gage side of the head of each rail, are supported by swinging right-angle levers, as shown in Fig. 1. Springs holds these wheels against the rails. Small steel cables carry the movements of the levers to an equalizer bar, which eliminates from the final record all movements but actual variations of gage. These variations are brought up to the table mechanically by means of a steel wire which actuates the recording pen.

When the gage recording device is not in service, the mechanism is lifted about 4 in. by releasing the air in a pneumatic cylinder. When passing through frogs at speeds greater than approximately 10 m.p.h., the gage wheels ride by without difficulty. If these gage wheels do go out, no harm is done, as the operator, by means of levers at the desk, can pull them up and set them down again in their proper positions.

Lateral Movement Mechanism—By the track gage mechanism, a record of side movement of the truck, with respect to the right rail, is also secured. When the truck lurches toward the right, the gage wheels remain against the rails and the levers lean to the right; the cables also move to the right and pull the equalizer bar to an inclined position, with the right end higher. When the truck lurches to the left, the same movements occur in the opposite direction.

Cross Level Mechanism—In a study of several track recording cars it was found that the cross-level record (of both track and car body) was the most difficult to control accurately. Experiments with the gyroscope showed that the forces set up when a passenger train rounds a sharp curve at high speed are much greater than those encountered by gyroscopes used at sea or in the air. However, after experimentation, the gyroscope has been successfully adapted to track records.

The gyroscope, Fig. 3, enclosed in a glass cabinet, is supported by a bracket attached to the side of the car above the recording table. It is of the double rotor type enclosed in cases and supported in a gimbal ring. These cases are connected by gear sectors requiring equal movement. The rotors revolve in a vertical longitudinal plane at a speed of 12,000 r.p.m., the right-hand rotor turning clockwise and the other counter clockwise. An air balancing device restrains the movement of the gyroscope from its normal position and brings it back to that position after it has been thrown out by some external force.

Car Body Inclination—In the left-hand drawing of Fig. 4, the pen bar is connected at its upper end with a bracket attached to the side of the car and its lower end causes the pen to record the inclination of the car, the bar being controlled by the gyroscope. This measurement is one of angular magnitude and is shown on the chart as divisions between reference lines ⅜ in. apart, one division being equal to 2 deg. of inclination.

Track Cross Level—To measure the cross level of the car truck by the mechanism shown on the right in Fig. 4, the movement is transferred to a horizontal cross bar near the roof of the car, by means of wire cords or cables. The bar is free to rotate about its center and moves vertically upon a guide. Vertical spring tension on the bar keeps the cables tight and causes the bar to follow the exact cross level of the track regardless of the swing or bounce of the car. In this way the superelevation of curve is shown. The pen bar is so connected with the gyroscope that it eliminates the car-body effect, and the final measurement recorded is true track cross level, the paper record being on ⅜ natural

scale. Without the corrective factor of the gyroscope, the record would show the difference in cross level of the track compared with that of the car body.

Time, Speed and Location—A clock is provided with two cams by which electric contact can be made at intervals of 10 or 30 seconds. When the contact is closed an electric current passes through an electro-magnet located on the recording desk close to the time pen and pulls the pen from its normal, neutral position, making an offset on the record.

The pen which records the time intervals is also utilized to show various landmarks, such as mile posts, stations, bridges, switches and road crossings. An electro-magnet operating the pen to record these identification marks is strong enough to pull the pen to the other side of its neutral position, even against the pull of the time magnet. This is done in order that the identification mark should always be registered. An observer on the rear platform telephones the operator at the desk the identification of the landmark as it is recorded.

Record Chart—By means of belt and flexible cable drive from the axle of the truck and reduction of speed by use of gears, the record paper is moved across the table (see Fig. 3) at the rate of 13.2 in. per mile of car run, regardless of the speed of the car. This affords a convenient scale (1 in. equals 400 ft.) and corresponds with standard profile paper. Upon this scale a 33-ft. rail length is approximately ½ in. Fig. 5 shows a section of the chart, on which notations as to the various records have been made. These records are as follows:

A. Lateral movement of car. Record of horizontal movement of equipment in relation to right-hand rail; seven-twelfths actual scale.

B. Low joints. Showing joints ¼, ½ and ¾ in. low on each rail.

C. Gage of track; natural scale.

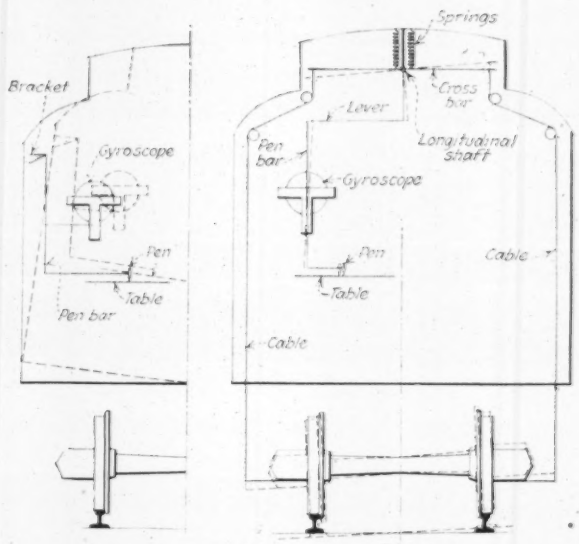


FIG. 4—GYROSCOPIC RECORDING APPARATUS
At left: Apparatus for inclination of car body. At right: Apparatus for inclination of car truck

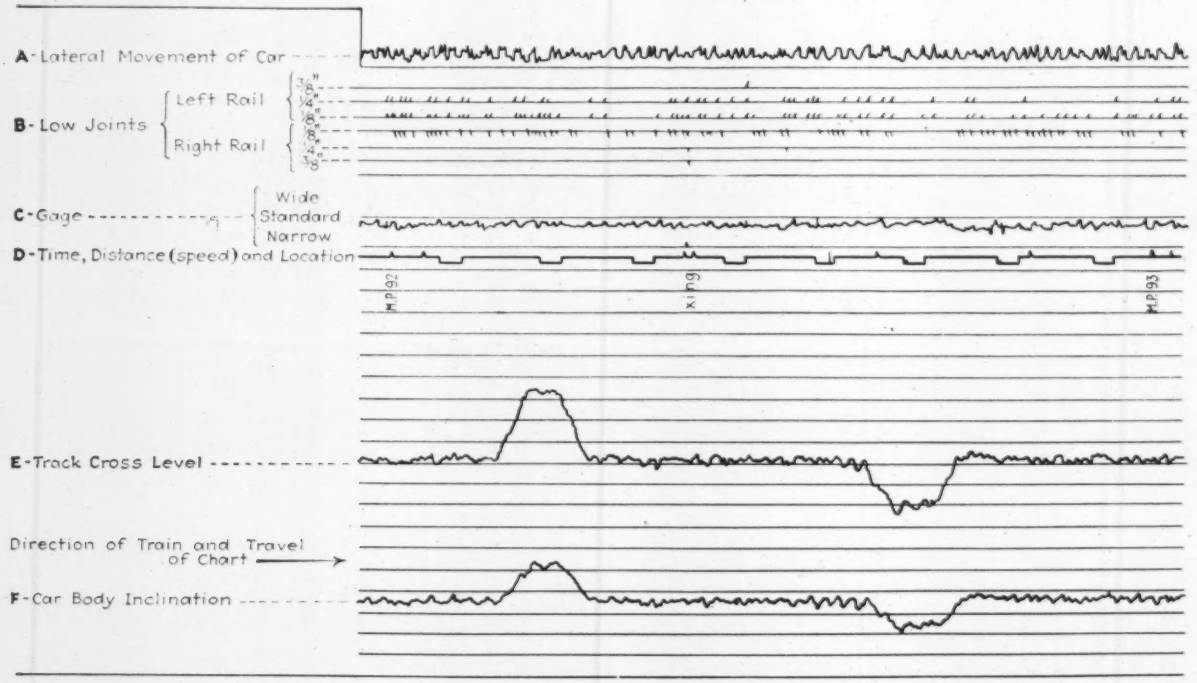


FIG. 5—SAMPLE OF TRACK-RECORD CHART

D. Time, distance (speed) and location. Offsets below base line indicate 10-second intervals. Distance, 1 in. equals 400 ft.; 1 mile equals 13.2 in. Location landmarks are indicated by offsets above base line.

E. Cross level of track. Each division (⅜ in. on actual chart) equals 1 in. superelevation. Offsets above and below indicate curves to left and right respectively.

F. Car-body inclination. Each division (⅜ in. on actual chart) represents 2 deg. of slope of car floor.

Uses of Track Recording Device—The principal use of the track-recorder car is to make a record of the conditions of surface and gage of the track; also the results of these on the riding qualities of the car, in both cross-level and lateral movement. It is pointed out specially that these characteristics are taken under load, whereas the trackman's measurements reflect the condition of the unloaded track structure. If these records are taken in the spring and fall, a comparison of the characteristics will show whether and to what extent, the condition of the track has been improved by the season's work. The record may be used also for comparing the characteristics of different sections of track and to determine the relative excellence of track constructed of different materials. A valuable use of the device may be to show the trackman exactly where the track is out of condition under load. While some foremen are so skillful as to locate and remedy low spots without wasted effort, other foremen are not so skillful. A test by furnishing half the foremen on a district with these records showed a saving of labor due to the use of records.

Credit should be given to Elmer A. Sperry, president of the Sperry Gyroscope Co., for the adaptation of the gyroscope to a track recording device; L. F. Carter, his assistant, supervised the installation of the device. Paul W. Steelsmith of the railway company's test department, aided in the design and construction of the device, and T. A. Blair, assistant engineer, aided in developing the recording device.

Five New Highway Bridges Across Mississippi River

New Crossings Being Built at Louisiana, Alton, Chain of Rocks, Cape Girardeau and Cairo

By H. H. Lotter
Highway Engineer, U. S. Bureau of Public Roads, Jefferson City, Mo.

INCREASING road traffic has created a demand for better crossing facilities over the Mississippi River between Missouri and Illinois. This demand is now being supplied by the building of five new substantial highway bridges.

Louisiana Bridge—Most northerly is that at Louisiana, Mo., now under construction and proposed for completion during the present year. Work is in progress on the main river piers, and erection of the two west spans is well under way. The bridge will consist of four steel through truss spans of 325 ft., a 150-ft. through truss approach span, and 410 ft. of steel trestle. There will be 1,800 ft. of earth embankment in the Illinois approach. The bridge will have a 20-ft. roadway paved with bituminous concrete. The total length of bridge and approaches is 4,450 ft., and the maximum grade 3.47 per cent. L. C. Stark of Louisiana is president of the company for which the bridge is being built. Plans were prepared by Harrington, Howard & Ash, of Kansas City. The estimated cost of the construction is $815,000, and this with the added cost of organizing and interest payments brings the total to $1,000,000. The bridge is located on U. S. Route 54.

Alton Bridge—The next bridge, as one descends the river, is that at Alton, Ill., which is also under construction. Its location is about 300 ft. downstream from the railroad bridge at this point. It will consist of seven through truss spans with a total length of 1,843 ft., the piers being caissons carried to rock.

This bridge is connected with the building of another bridge, some four miles away, over the Missouri River at Ft. Bellefontaine, Mo. The Bellefontaine bridge will be located a short distance downstream from the present C. B. & Q. railway bridge, about six miles from the mouth of the Missouri. These bridges, one over the Mississippi and one over the Missouri, are to be connected by four miles of 20-ft. pavement, with an additional 1.5 miles of pavement south of the Bellefontaine bridge to connect with the Bellefontaine road in St. Louis County. They will shorten the distance between Alton and St. Louis. Much additional traffic is expected from Illinois Highways 4 and 11 carrying travel from the north and east to the west.

Alton furnished $700,000 of the money necessary to build this St. Louis connection, and the project is well under way. H. H. Ferguson, of St. Louis, is president of the company. Promotion of the project was originally carried out by state senator A. L. McCawley of Carthage, Mo. The estimated cost of the two bridges is $2,650,000. Work has been started on the Alton bridge and the work will be pushed to early completion.

Chain of Rocks Bridge—The proposed Chain of Rocks-Kings Highway bridge has received War Department approval and financing is under way. Actual work may begin shortly. The bridge will be 300 ft. north of the new intake of the St. Louis water-works, at the Chain of Rocks. It will be 5,400 ft. long, consisting of seven 200-ft. spans, two 300-ft. spans, five 400-ft. spans, and two 700-ft. spans, all with 20-ft. roadway. It is estimated to cost $2,300,000, with highway connections. John R. Scott, of St. Louis, is the president of the company; plans were prepared by E. B. Ray and Baxter L. Brown, of St. Louis, Mo. The bridge will avoid numerous grade crossings found on present routes over the bridges at St. Louis.

Cape Girardeau Bridge—The Cape Girardeau bridge, under construction, will cost $1,600,000. Plans were prepared by Harrington, Howard & Ash. C. L. Harrison, of Cape Girardeau, Mo., is president of the company. The bridge will consist of seven through steel trusses on caissons sunk to rock, and with approaches will be 3,226 ft. long. It will have a 20-ft. roadway with bituminous pavement. It is estimated that 110,000 autos will be diverted over the bridge, that being approximately the number now using ferries over the Mississippi at this and adjacent points.

Cairo Bridge—A bridge is also under construction at Cairo, Ill., connecting that city with Bird's Point, Mo. It is a $2,000,000 project, and will connect Illinois Highway No. 2 (Bloomington to Cairo) with U. S. Highway 60 in Missouri, Bird's Point to Springfield, where it joins U. S. Highway 66. This structure also will consist of steel truss spans on caissons to rock. It will solve a definite traffic problem, as at this time several ferry companies are kept busy and considerable rivalry has existed over the increasing trade developing; special laws were enacted by the county officials to control the situation.

Web Stresses in Concrete Beams

Tests of 139 reinforced-concrete beams to investigate shear failures and web stresses are reported by Prof. F. E. Richart in Illinois Engineering Experiment Station Bulletin 166, just issued. The tests extended over a 12-year period, and dealt with spans of 6 to 10 ft., depths of 10 to 21 in., and flange widths up to 20 in., loaded usually at the third-points. In the beams which had no web reinforcement, failure was by diagonal tension at shearing unit stresses from 130 to 580 lb. per sq.in. (most of them between 130 and 250); failure occurred suddenly, without display of toughness. Beams with web reinforcement always showed gradual yielding. They exhibited the largest amounts of diagonal tension in the region between load-point and support, while near load and support the diagonal tension was relatively small. The diagonal tension reached large values in those beams which were under heavy shearing stress compared to the bending stress—that is, short and deep beams and those having large percentages of longitudinal steel. However, these beams also showed the highest shear capacity. Adequate anchorage of both longitudinal and web steel was found to be important. Generally the observed stresses in the web steel were well below the stresses calculated on the assumption that the web steel carries all the shear, and approximated those corresponding to division of the shear between concrete and steel sections (with 100 lb. per sq.in. shear for ordinary concrete and 200 lb. per sq.in. for strong concrete). But with increasing percentage of web reinforcement the proportion of the total shear carried by the web steel increased. Vertical web members were about equally effective with those inclined at 45 degrees.

State Highway Developments of 1926 Awarded Blue Ribbon of Distinction by State Highway Engineers

SEVENTH ARTICLE

Station Work—Day Labor Road Building

By C. M. Hathaway
Engineer of Construction, Division of Highways, Springfield, Ill.

A STATION WORK OUTFIT ON GRADING

THE GRADE and alignment of the existing road between Kampsville and Hardin, Ill., made its utilization impracticable when measured by the usual standards required for modern state road construction. The first problem, therefore, was that of location. It was evident that a hill road was prohibitive on account of steep grades and a low water road was impracticable due to frequent high water in the Illinois River. A topographic survey was made of the area from the river bank back into the hills and the location was determined from a contour map. The road as finally selected skirted the bluff, and the cuts and fills were so balanced that enough earth was taken from the side to fill the bottom lands to a grade above maximum high water, thus a satisfactory alignment was obtained with grades not over 2 per cent.

Grading by Station Method—Due to the large amount of earth work involved, a contract was awarded, late in 1923, for the heavy grading and bridges, in accordance with the usual Illinois policy requiring the settlement of deep fills before the placing of the pavement.

The plans anticipated rock excavation, and as work progressed it was found that this assumption was correct. The contractor organized with a wheeler outfit but it soon became necessary to add to the equipment a steam shovel and wagons. Later as the excavation proceeded into the bluffs and side hills, wheelers and shovel both proved uneconomical methods of earth moving and the contractor resorted to the old time method of station work, sections 100 ft. in length assigned to squads of two or three men. The inter-mixed rock and earth was first shot, broken, and loaded with picks and shovels, and then transported in wheelbarrows and carts to the fill. The greatest percentage of the excavation was finally moved in this manner. To those unfamiliar with station work it might seem that such a method could obtain only very slow progress, but with a large crew of station men working continuously, the work actually progressed in a very satisfactory manner and the entire grading operations from Hardin to Kampsville were completed early in 1925.

Force Work for Paving—Due to the manner in which the fills were made it was deemed practicable to place the pavement during 1926. Here a distinct problem was presented to the engineer in the several uncertain elements involved in the construction of a concrete pavement, where the source of materials, delivery of aggregates, plant setup, labor conditions, and stage of water were all uncertain. All of these items must be considered by the contractor in making his bid and they would have been difficult to estimate. Consequently no responsible contractor could afford to place a rational bid unless he allowed himself an unusual factor of safety. The department, realizing this, assigned the paving of this section to one of the state day-labor outfits.

The location of a suitable supply of aggregate was first considered. There was a large amount of rock located in the hills but due to its somewhat uncertain quality, the long haul from the source of supply to the job, and the usual high cost of plant installation, it was not deemed practical to open up a quarry for such a short section of work. Railroad facilities were impossible; therefore, it was necessary to consider shipping in the materials by water. This plan naturally introduced another problem, that of plant arrangement, since all the unloading equipment must be located on the river bank accessible to barges and at the same time there must be room for a good plant layout situated above ordinary flood stage.

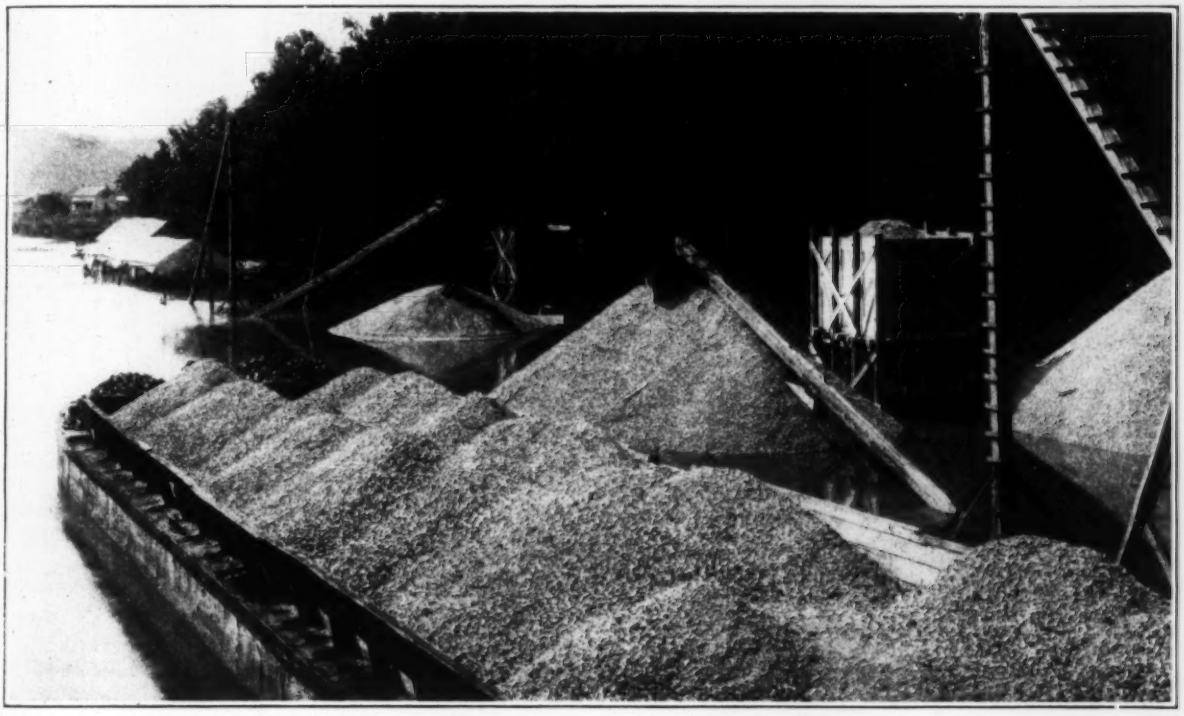
A point near the center of the job was essential to secure a low average haul, but before the location was definitely settled upon a careful study was made of the river stage over a period of years. Storage space

ILLINOIS

STATE bond issue road 38 traverses Calhoun County, Illinois, for a distance of 10 miles connecting the towns of Kampsville and Hardin, but located on the west bank of the Illinois River. Calhoun is the only county in Illinois without rail connection. It is very rough and the portion bordering the river is a series of hills, valleys and steep bluffs. These conditions and others described made it an appropriate operation to be undertaken directly by the state.— Frank T. Sheets, *State Highway Engineer.*

for ample quantities of coarse and fine aggregate was provided to offset irregular shipments. Two stiff-leg derricks were erected so that the boom and bucket could swing out over the barges and then back to the storage pile and loading bins. A cement shed with the capacity of 2,000 bbl. was constructed, also accessible to barge delivery. Two other features of plant arrangement were in accordance with standard practice.

Arrangements were made with a barging company to handle shipments of stone and sand from points farther south on the river and two stone barges with a capacity of 500 tons each and two sand barges of 200 tons each were placed in service. One towboat handled the barges, hauling one barge of stone and one of sand while the other two were loading. The stone was obtained from a quarry near East St. Louis, loaded into railroad cars, transported to the river bank in East St. Louis and there transferred to barge. No special equipment was required for this as there was utilized a plant erected for the purpose of transferring coal under similar conditions. The sand was dredged from the Mississippi River by a materials firm which had the equipment for barge loading.



FLOOD DROWNS OUT ROAD CONSTRUCTION MATERIALS PLANT

Two steel barges of 2,500 bbl capacity each and a towboat were furnished to transport cement from the mill at Hannibal, Mo., to the job. Each barge had a suitable covering of canvas to protect the cement in transit.

A standard paving outfit was employed, there being utilized a 21-E mixer, and for hauling, a fleet of two-batch auto cars.

Water Shipment Problems—The subgrade excavation occasioned considerable extra work due to the large rock content in both cuts and fills but otherwise paving conditions were similar to those of the average job. Paving started June 28, with prospects for good progress. However, it took only a short time to develop the fact that there are some problems in barge transportation that are not common to railroad traffic, and that had not been anticipated by either the barging company or the engineers in charge. Fluctuations in river stage interfered with the towboat schedule, as a low stage necessitated lighter loading; a shut-down at the stone quarry delayed loading of stone and a leaky barge hindered sand shipments. These combined difficulties produced delays which tied up deliveries for so long a period of time that the storage facilities could not bridge over the gap. In addition, rainy weather delays or a shut-down of the unloading equipment at the plant would tie up the barge and towboat, thus holding up progress on both ends. Consequently paving was not continuous until the entire situation was given careful study and a revision of shipping plans agreed upon. Additional equipment was installed by the barging company and after several adjustments had been made, shipments began to come through in a satisfactory manner.

Flood Delays—During August abnormal rains occurred in the Illinois River valley which continued at regular intervals for a period of eight weeks, and a flood stage in the tributaries was followed by a similar condition in the Illinois River. Never before in recent history of that section have such floods occurred during the summer season and the progress records for western and central Illinois indicate that during August, September, and the early part of October, all road and bridge construction was practically at a standstill. New high-water marks were established along the Illinois River for its entire length. In spite of the careful calculations made before locating the plant site it became apparent that the river would soon cover it and quick action on the part of the superintendent of construction was required to move the cement then in storage to higher ground and to transfer all movable equipment above the possible high-water stage. The plant was covered with 4

to 8 ft. of water until about October and all paving operations were stopped. The accompanying view will give the reader some idea of the problems caused by this unusual high water.

During October the river fell and it appeared that operations might be resumed but a second rainfall occurred which again put the river out of its banks and resulted in a flood stage nearly as destructive as the first. Thus operations were definitely closed down for the season and instead of laying 10 miles of pavement as had been originally planned, only 4½ miles were completed.

It might appear that the organization got the worst of the battle in the year's program and that presents the thought as to what the result might have been had this particular job been bid off by some contractor at the usual prices. As a matter of fact, no cement was lost, most of the stored aggregates could be salvaged, all equipment was stored above high water for the winter and only a nominal cost for demurrage resulted. The most serious loss was time on idle equipment and full time cost of the operators retained during the flood period.

It was a rather trying year for the superintendent in charge of construction but after all it was acknowledged at the start as one of those problems unusual in its nature and in the solving of which the engineer had an opportunity to develop unique methods of design and construction practice. This is just the job that demands the ingenuity of the engineer superintendent, and when completed it can be regarded as something accomplished in terms other than cubic yards of earth moved and square yards of pavement in place.

This work was under the direction of the Division of Highways, Department of Public Works and Buildings of Illinois, Frank T. Sheets, chief highway engineer. The engineering supervision was handled by Charles M. Slaymaker, district engineer of District 8, and the construction work was supervised by George H. Baker, general superintendent of day-labor construction, and R. C. Elder, resident construction superintendent.

Chart of Trade Union Membership 1899-1926

The National Industrial Conference Board has prepared a chart, No. 163, showing the growth of organized labor according to the size of union membership in the several industrial groups selected, covering the period from 1899 to 1926. The total American trade union membership in 1926 was 4,413,523, as compared with the maximum figure 5,110,800 which was reached in 1920. From 1899 to 1917 union memberships in all industrial groups showed an upward trend and in 1917 had reached the figure 3,104,600, which was four times what it was in 1899. This occurred in a period in which industry was expanding and considerable social and economic unrest existed. A more rapid growth has taken place since the war, due primarily to abnormal expansion and changes in industry. Immigrant labor was limited and governmental agencies were compelled to deal directly with labor unions in order to insure uninterrupted production. This action naturally fostered the growth of union membership. The chart indicates that trade union memberships, in general, follow the prosperity or depression in each industry.

Operation of Sewage-Works of Pontiac, Mich.

Recent Experience with Imhoff Tanks' Revolving Sprinklers, Final Tanks and Sludge-Drying Beds—Two Years' Operating Costs

By James R. Pollock
City Engineer, Pontiac, Mich.

REVOLVING sprinklers of the English type were adopted for the sewage-works of Pontiac, Mich., primarily to avoid pumping. This plant, built in 1920 after plans by Clarence W. Hubbell, consulting engineer, Detroit, consists of grit chambers, Imhoff tanks, sprinkling filters, secondary tanks and a sludge drying bed. The effluent discharges into Clinton River, which has a dry-weather flow of not to exceed 13 sec.-ft., giving a dilution of not more than 0.3 sec.-ft. per 1,000 population. The plant was designed for a population of 52,000. With the construction of an additional Imhoff tank it would provide for 68,000 people without additional filters. The 60-in. outfall sewer is designed to carry the sewage from an ultimate population of 215,000.

Grit Chamber—Each of the two compartments is 5x23 ft., 7 ft. deep below flow line, has a bar screen, and is provided with a gate valve. The chambers are cleaned on an average twice a month. Rags and other materials which accumulate on the screens are raked off several times daily, thrown into metal carts and hauled to the dumping ground. One of the compartments accumulates much more grit than the other, since the outfall sewer enters on a curve and throws the heavier suspended matter to one side.

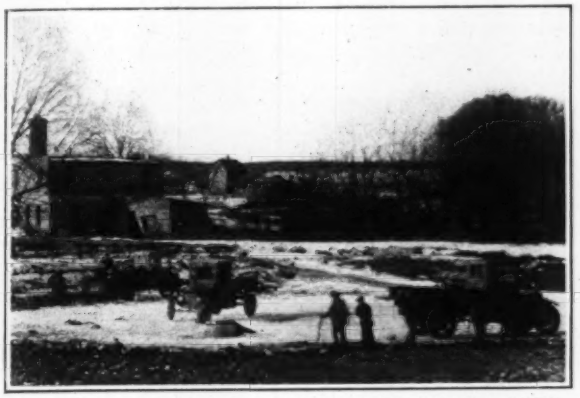
Imhoff Tanks—These are of the rectangular, reversible-flow type, 33x98½ ft. at the flow-through level and 7½ ft. deep to the slopes. The sludge capacity is 1.40 cu.ft. per capita. Direction of flow in the tanks is reversed once a week.

Pontiac being an industrial city (chiefly automobile manufacturing), some oil finds its way into the sewers and tanks, as does grease from a packing plant. Oil and grease that accumulate in the grit chambers are skimmed off and emptied into carts. The surfaces of the Imhoff tanks are cleaned of grease by hand skimming as often as may be necessary. Attempts to break up this grease and cause it to settle have been unsuccessful. It was formerly the practice to empty the grease into the gas vents, but this was not satisfactory.

Considerable foaming in the Imhoff tanks occurred in 1926, due in part to an overload of sludge and in part to hot weather. Plunging of the gas vents seemed to give no relief and the only temporary relief obtained was by the liberal use of hose and water. A heavy hosing of the vents would hold down foaming for three or four hours. Drawing off a bed of sludge would give relief for a few days only. This condition existed during July and August and subsided as soon as cooler weather arrived in September.

Finely shredded hay is delivered to the sewers by the packing plant. During the summer this rises in the gas vents and becomes as much as 6 ft. deep and heavy enough to support a man. In the autumn of both 1925 and of 1926, 180 cu.yd. of this material was removed from the gas vents by pitchforks.

Sprinkling Filters—The eight circular filters are 110 ft. in diameter and have a stone depth of 6 ft. The revolving arms, four to each bed, are suspended from a central bearing. Each arm has a series of ⅜-in. openings spaced from 12 in. near the center to 3 in. at the periphery of the filter. Each arm is provided with a shear valve at the outer end to facilitate cleaning. These arms operate under a head of 14 in. If the ordinary type of sprinkler system had been used, pumping of the sewage would have been necessary. The normal dry weather



WINTER REMOVAL OF SLUDGE FROM DRYING BEDS
Ford motor trucks driven onto the frozen sludge for loading with forks.

flow of 3.8 m.g.d. is sufficient to keep five or six of the sprinkler arms rotating. The normal peripheral speed of rotation is about an average walking gait. Some pooling on the filter surface occurred in 1926 but this was relieved by using a horse and spike-tooth drag to loosen the surface of the stone.

Each filter is given one week's rest in four, but whether this is beneficial cannot be definitely stated. Cold weather has never caused a shut-down of the filters, although temperatures of —20 deg. F. have been recorded. Some mornings a ring of ice has formed around the edge of the filters, but this is soon removed by opening the shear valve at the end of the sprinkler arm and allowing a heavy stream of sewage to wash onto this ice. About once a day the holes in the sprinkler arms are cleaned with a rod.

OPERATING COSTS OF PONTIAC SEWAGE-WORKS

	1925	1926
Repairs	$481.86	$197.19
Water	218.10	1,259.50
Heat and light	82.47	225.26
Supplies	458.49	234.33
Sludge removal	2,670.61	3,297.90
General operation	2,801.14	3,404.55
New equipment	171.12	9.50
Telephone and telegraph	35.88	37.50
General overhead	207.19	
Sundry	14.85	180.21
	$7,141.71	$8,845.94
Tributary population	47,000	53,000
Volume treated m.g.	1,314	1,475
Cost per capita	$0.152	$0.167
Cost per m.g.	5.44	6.00

Secondary Tanks—Each of the three secondary tanks has an inside diameter of 30 ft. and a depth of 14½ ft. to the bottom slopes, which are 1 on 2. Sludge is pumped to the Imhoff tanks once a day. Due to the flatness of the slopes it is impossible to prevent the sludge accumulating on the tank bottoms. The only successful means of thoroughly cleaning the tanks has been to suspend a weighted fire hose in the tank and keep working it around the bottom with a good pressure on, at the same time operating the sludge pump. The ground water elevation makes it unsafe to pump the tanks dry for cleaning.

Sludge Bed—One ½-acre sludge bed is provided, giving less than 0.5 sq.ft. of drying bed area per capita. It consists of 12 in. of local sand above underdrains embedded in gravel. Lack of sludge drying area has been one of the chief operating difficulties the past two seasons.

In the summer we have removed two beds of sludge per month, with favorable weather conditions, but in the fall and winter we may run for nearly three months. In 1925 and 1926 we removed 14 and 13 beds respectively. During the winter the sludge is usually frozen when removed. It is loaded by forks into motor trucks which in summer run over the bed on plankways and in the winter over the frozen sludge. A bed of sludge when first drawn is about 12 in. deep and dries to a depth of 4 or 5 in. Sludge is dumped on low land at the site of the plant, as there is practically no demand for it from farmers.

In normal operation the plant is taken care of by the superintendent and one helper, with additional help when necessary. Sludge removal is effected by a part of the street maintenance crew, which makes for flexible and economical operation. The accompanying table gives some cost figures for 1925 and 1926; the heavy water charge in 1926 was due to excessive foaming already mentioned.

English Main-Line Articulated Locomotives

An innovation in English railway practice is the use of articulated locomotives for regular main-line service. The first of such engines for this class of service are three which have been introduced for hauling heavy freight trains on the London, Midland & Scottish Ry., in order to obtain great increase in power without excessive axle loads or such long rigid wheelbase as to be hard on the track. While the Mallet type of articulated locomotive has been developed and used extensively on American railways, the English engineers have adopted the Garrett type, which has been used in a number of the British colonies and also in South America. In this type of engine, the boiler is mounted on a steel underframe similar to that of a freight car and supported at each end by a pivot bearing on a steam-truck and close to the main or middle driving axle of the truck. In the English engines the trucks have the 2:6:0 wheel arrangement, so that the engine is of the 2:6:0-0:6:2 type. On one truck is a tank of 2,700-gal. capacity, while the other carries an 1,800-gal. tank and a 7-ton coal bunker. Both tanks are fitted to take water from track tanks. The general dimensions of these engines, which were designed under the direction of Henry Fowler, chief mechanical engineer of the railway, are: Driving wheelbase, each truck, 16 ft. 6 in., total wheelbase, each truck, 25 ft. 9 in., total wheelbase of engine, 79 ft. 0 in., weight in working order, on each group of drivers, 58 tons, on each truck, 16 tons, total 148 tons. Articulated locomotives used on the Uintah Ry. in the Rocky Mountains in America were described in *Engineering News-Record* Aug. 4, 1927, p. 190.

N. Y. Canal Terminals Designed for Rapid Cargo Handling

Terminals Built by State at Cities on Barge Canal Are Arranged for Economical Movement of Many Kinds of Freight

By Maurice W. Williams
Consulting Engineer, New York, N. Y.

THE New York Barge Canal system contains the most extensive group of terminals under one management on any inland waterway in the world. All told there are sixty of them, and they have been constructed not only at the main interchange points at New York, Buffalo and Oswego, but also at every city and many villages on the line of the Barge Canal and connecting waterways. They have cost about $20,000,000.

The purpose of installing terminals is to provide places where any barge can land or receive freight for any shipper or consignee. They have therefore been designed and equipped to meet average conditions, with due regard to local variations.

Bulk freight on waterways tends to move in large lots and to be handled at terminals specially designed for the purpose, and most of such terminals are privately operated. Grain, for example, which constitutes by far the largest single element of tonnage on the Barge Canal, is unloaded from lake vessels at Buffalo and loaded into canal barges in a very efficient manner at privately-owned elevators, these being nothing else than terminals designed for particular commodities.

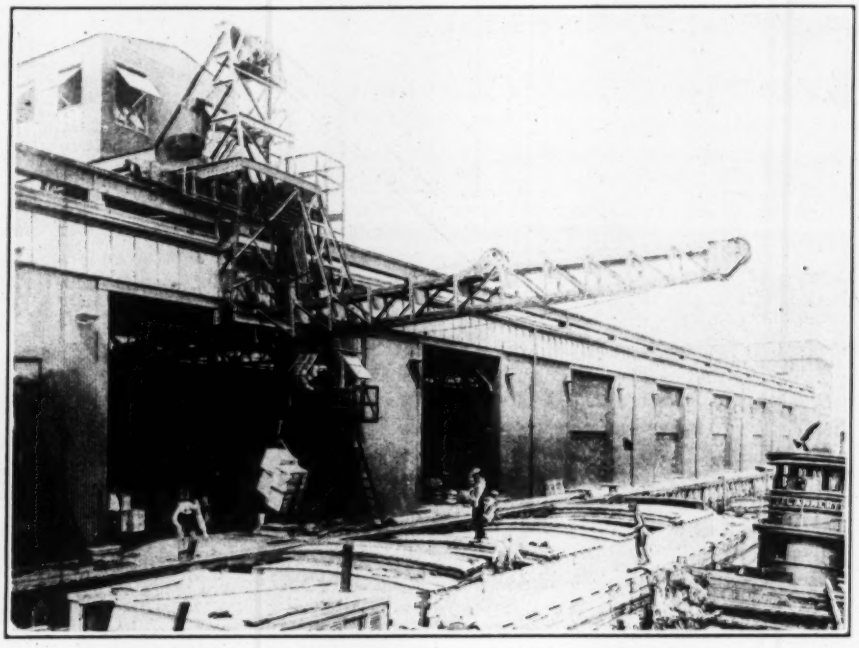


FIG. 1—ROOF CRANE, PIER 6, EAST RIVER, NEW YORK
Traveling electric luffing-jib crane of the conveyor type designed to reach to a second line of barges lying at the pier.

Space has been provided at all except a few terminals for temporarily storing bulk freight, especially of the lower grades, like sand and crushed stone.

The route of the Barge Canal system is in most places remote from that of the older canals which it displaces, due to its being a low-level system, occupying the beds of streams, while they were of the high-level type and occupied the sides of the valleys. The Barge Canal is therefore in most places at some distance from the industrial plants which lined the banks of the older system. Many commercial establishments, such as the wholesale groceries of Utica, found it to their advantage to utilize water transportation and were consequently located alongside the canal where the commodities could pass directly between barge and warehouse. They, too, are now marooned. To meet this condition it has been the aim to provide freight sheds at most of the terminals for temporarily storing the commodities, like package freight in general, which need protection. Considerable portions of a number of the terminals are given over entirely to facilities for handling package freight, such as the piers at Erie Basin, Buffalo, and Greenpoint and Gowanus Bay, New York, but only one terminal, Pier 6, East River, New York, has no facilities for handling bulk freight.

It has been well that the state has provided the public terminals, since private capital has so far provided only two for general use, one each at Rochester and Niagara Falls, although it is likely that many of the cities would have installed excellent facilities had not the state adopted the policy of furnishing them. Of course many privately owned terminals of a general nature, such as those at New York, Buffalo, Troy and Oswego, have been constantly available under restrictions imposed by the owners.

It should be borne in mind that, while the Barge Canal in general occupies the beds of the streams, the system of navigation is that of slack-water pools created by dams and locks on the order of those in the Ohio River. Only in the Hudson River below the federal dam at Troy is the river used in the same manner as the Mississippi, but even there the stream is tidal and really becomes a free-flowing one to any extent only at flood stage. The heights of the terminal tops above pool therefore refer to minimum stage of the latter, while navigation can be and is conducted at stages of water several feet higher.

Terminals have been built at 50 points, while the Barge Canal as constructed at 10 other points has provided a wharf susceptible of use when properly equipped. At a few of these 50 points, such as Lockport and the Tonawandas, a canal wall has simply been raised and otherwise fitted for terminal use. At a number of them, such as Erie Basin, Buffalo, and Greenpoint and Pier 6, New York, the terminal comprises more than one pier: strictly speaking, Pier 5 is distinct from Pier 6, but is seldom referred to as such. In each case, except the least important, a general plan for development has been

adopted which controls the nature and extent of each element as it is constructed or installed, with the purpose of making the ensemble harmonious and avoiding waste.

The 50 terminals built as such comprise 46,000 lin.ft. of dockage measured on the perimeters of piers, quays and basins, and comprise those in all the largest cities. The 10 terminals made possible by ordinary canal construction measure 10,173 ft. and as a rule are found only at the less important points. At Rochester, however, some 2,552 ft. of such wharfage exist in addition to the specially designed terminal, while Fulton, Seneca Falls and Baldwinsville, thriving industrial places, have 1,480, 1,284 and 280 ft. respectively.

Of the 50 terminals built as such, those of the pier type measure 18,530 ft., including pier and slip ends as well as usable bulkheading of a supplementary nature, while the quays measure 27,471 ft. Included in the last category are the basins at Hallet's Cove, New York, and Ohio Basin, Buffalo, which simply are quays surrounding open water. The Syracuse terminal, which consists essentially of two piers projecting into a basin, is classified in the pier type. Naturally the 10 wharves built in ordinary canal construction are all quays. Erie Basin, Buffalo, is of the pier type, not a basin, the name being an old one.

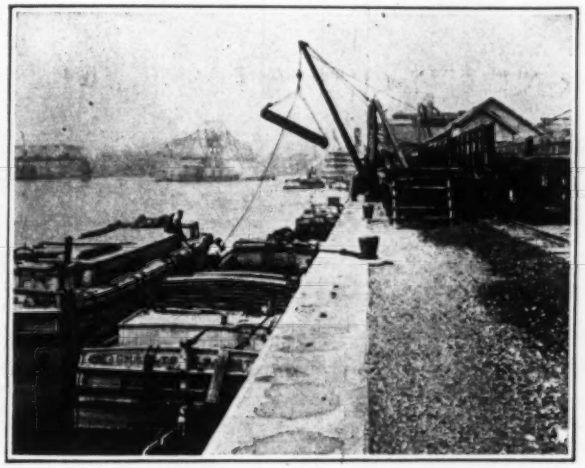


FIG. 2—RIVERSIDE TERMINAL AT TROY
Showing inexpensive wooden derrick crane equipped with electric hoisting motor.

The height of the wharf tops of the 60 terminals above pool level varies between 2.2 ft. and 16.9 ft., the average being 6.5 ft. There are only two whose heights are greater than 9.5 ft., these being Troy, 16.9 ft., and Albany, 11.5 ft., the effort in both cases being to build high enough to prevent inundation by all but the greatest floods. The least heights are all in landline portions of the canal where spillways prevent rises of more than a few inches in pool level.

The depth in the dock is 12 ft. at low water, except that about 23 ft. are provided at Oswego (lake terminal) and Ohio basin and Erie Basin, Buffalo. The depth at Gowanus Bay is about 25 ft. All of these terminals are transfer points which can also be used by deep-draft vessels.

Both quays and piers are of many designs, the former comprising crib, gravity wall, steel sheetpiling, concrete sheetpiling and other varieties of construction while the piers are of both the solid-fill and pile types. In general the gravity wall predominates for quays while the pile type is standard for New York piers on account of the requirements of maintaining the tidal prism, and solid fill for piers prevails elsewhere. Most of the pile piers have concrete decks, and a number use precast concrete members above the elevation of low tide.

A primary consideration in equipping a terminal for use is to pave it so that drays and motor trucks can reach as much of it as they should. Gravel, macadam, brick, stone block, concrete, and asphalt on concrete are all used, while on some of the less important terminals, where the traffic so far has been light, little attention has been paid to the pavement aside from a cheap driveway connection to the adjacent street. The aim is to make the quality and extent of the pavement at any particular terminal conform to the needs at that place.

Freight sheds have been built on 39 of the terminals. These range from a simple wooden affair only 16 to 30 ft., like the one at Mechanicsville, to a massive steel structure on the Gowanus Bay pier which is one of the largest in New York. Reinforced concrete, brick and hollow tile are also materials of construction. A feature of most of the permanent quay sheds is the slope up of the wharf top and shed floor back from the water, with the idea of bringing the floor at the rear of the shed up to dray-tail level. This is an improvement over depressing the roadway in the rear of the shed to make the difference in level between shed floor and roadway, as that treatment often gives insufficient drainage.

Equipment for handling freight is an outstanding feature of the terminals as a whole. This has been provided for the reason that virtually all of the barges in use today carry the load in the hold instead of on a deck, and therefore means have to be provided for handling freight in and out of the hold, since almost no barges carry the slightest means for handling freight.

FIG. 3—SELF-PROPELLED STEAM CRANE AT ALBANY

The barge which arrives in New York loaded with grain returns West with a load of some sort of freight, whether it be sand, sugar or sardines, which must be hoisted out a little at a time at some terminal elsewhere. Freight handling equipment therefore is essentially of the lifting type such as cranes rather than of the horizontally-conveying type like monorails. The horizontal element has not been lost sight of, however.

The crane is the typical freight-handling device with which the terminals are equipped. The type of which the greatest number have been installed is the wooden hand-operated ½-ton derrick-crane, there being some 22 of these. They were procured primarily as an emergency measure when more suitable apparatus could

hardly be secured, and on the larger terminals are considered to be only for auxiliary use. A few of these cranes were supplied with electric motor where the amount of use warranted the expense. The next most extensively used type is the 2-ton steam auto-crane of which there are 20. While originally procured as an emergency measure they are considered to be a part of the regular equipment of a number of the terminals. Since they are self-contained units they may be switched from one terminal to another as traffic demands. Next in order comes a very high type of equipment, some of the first to be installed in this country, consisting of 10 3-ton electric semi-portal jib cranes in 5 pairs on as many different important terminals. The semi-portal wharf cranes used at the Boston army supply base are generally similar to them. There are 6 steam 5-ton portal jib cranes which were procured from the War Department as excess equipment. There are also 6 steel derrick-cranes, in capacity ranging from 12 to 25 tons, several of which have been fitted with electric motors or steam winches. The 1½-ton electric straight-line roof crane with luffing jib is represented by 4 examples, two each at two terminals. Four wooden derrick cranes of 4 tons capacity are used at Rochester, generally similar to the 22 cranes first noted above, but with greater capacity.

For handling bulk materials, especially of the free-flowing varieties, a 5-ton electric bridge crane has been installed at each of two terminals. Revolving-jib caterpillar cranes have also been made a part of two terminals. One luffing-jib burtoning crane of an altogether new type, which handles cargo by means of a hook controlled by one line running from a point over the wharf and another line running from a point over the vessel, as may be seen any day at fifty steamship piers in New York, has been installed on the wharf shed at Mott Haven. An 8-ton steam derrick-crane has been installed at Rochester. There is only one regulation locomotive crane.

Conveyors have not been overlooked, there being two 800-lb. portable machines of the apron type and two smaller brick conveyors. A number of electric storage battery tractors, with a complement of 2-wheel-steer trailers, have been procured, as well as two electric elevating-platform trucks. Several of the larger cranes have been equipped with electric magnets.

In general the terminals are well supplied with equipment for handling freight at present, although the steady growth of canal traffic will undoubtedly necessitate the installation of a great deal more in the future.

Many accessories have been supplied as part of the regular equipment of a number of the terminals, such as heavy truck scales and hand trucks.

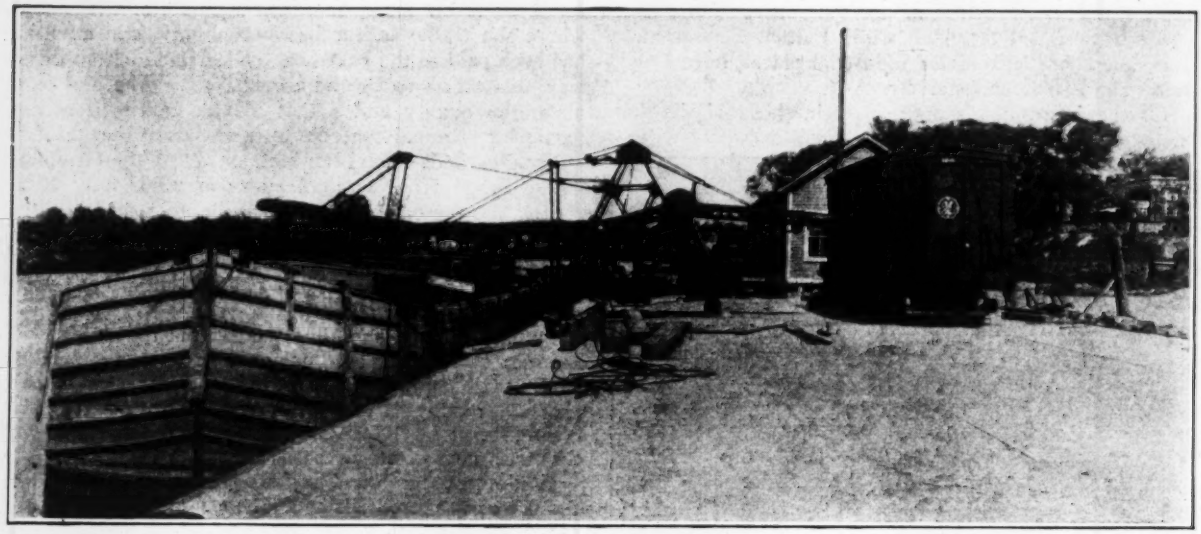


FIG. 4—PORTABLE ELECTRIC PACKAGE FREIGHT UNLOADER AT SCHENECTADY

Two special-commodity terminals have been built, a 2,000,000-bushel grain elevator at Gowanus Bay, Brooklyn, and a 1,000,000-bushel elevator at Oswego, the latter having been completed only recently.

Effective Channel Control Work On Columbia River

RESULTS of the annual soundings and surveys at the mouth of the Columbia River indicate that the river control work carried on by the United States engineers has been very effective in deepening and widening the channels, according to a report of the officials of the port of Astoria, Ore. The original Columbia River channel project sought to achieve a minimum depth of 40 ft. at mean low tide and a channel width of 600 ft. This was accomplished in 1916 after nearly thirty years of work, during which time one jetty seven miles long and one three miles long were constructed and much dredging work was done. Since that time no dredging has been done because the engineers were convinced that the current set up by the jetties would continue to widen and deepen the river channel.

The 1927 survey shows that there is now a minimum depth of 47 ft. of water at mean low tide over a width of 2,000 ft. This is an increase of 1,400 ft. in the 47-ft. channel since 1926. The 46-ft. channel which is considered the main fairway for vessels at the mouth of the river, now has a width of 3,400 ft., an increase of 900 ft. over the preceding year. The 40-ft. depth now exists over a channel width of 6,800 ft., as compared with 6,000 ft. for the 1926 survey. There has been no increase in depth during the year, the changes being in an extension of the deeper sections.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Reinforced-Concrete Buildings

REVIEWED BY ARTHUR R. LORD
Of Lord & Hollinger, Architectural and Civil Engineers, Chicago, Ill.

CONCRETE BUILDING CONSTRUCTION—By Theodore Crane, C.E., Associate Professor of Building Construction, Sheffield Scientific School, Yale University. Edited by the late Thomas Nolan, M.S., A.M., Fellow of the American Institute of Architects and formerly Professor of Architectural Construction, University of Pennsylvania. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Flexible; 6x9 in.; pp. 689; many halftones and line cuts; tables, bibliography. $6.

Another book on concrete—and an exceptionally good one! A favorable impression is imparted by the well considered arrangement and organization of the matte presented and by the typography and illustrations. A high degree of condensation is necessarily involved in a text that covers in less than 700 pp. the entire field of reinforced-concrete building construction. This compactness is much to the reader's advantage on the whole. I find remarkably little in this book which is not accurate and the student who masters the subject from this text will have little to "unlearn" in later years.

For the designer of reinforced-concrete structures this book covers the fundamental principles of design theory by the usual straight line analysis; the mechanics of shear and moment, including continuous beams and rigid frames (slope deflection method); the practical design of reinforced-concrete members of every type commonly found in practice and a good discussion of waterproofing. In the second edition I trust that more of those tables, diagrams and office standardization devices, which make accurate designing commercially practical in large engineering offices, may find their way into these chapters. This omission may be intentional and due to the great diversity in city building regulations throughout the country. Many tables are encumbered by the inclusion of numerous bar sizes which have long since been eliminated from reinforcing bar stocks and can only be obtained by special order. Several tables could well be eliminated entirely due to the successful activities of the Division of Simplified Practice of the Department of Commerce.

For the contractor's forces this book includes one of the best treatments that I have seen on practical methods of estimating and of cost accounting as the basis for estimating. While each contracting office has its own system in these matters, the one presented here is fairly representative of the best practice. The subjects of purchasing and sub-contract management are also well handled. The inclusion of many standard forms for contracts, proposals, estimate sheets, order sheets, etc., makes this a handy reference volume in this field. The discussions of formwork design and erection and of reinforcing steel fabrication and setting are also very complete.

The treatment of concrete materials and proportioning includes all of the many proposed methods and suffers somewhat from its very inclusiveness. The subject is a tremendous one to attempt to treat in a part of one chapter—even of 60 pp.—and the discussion leaves off without developing adequately any one definite and practical method of proportioning concrete on the job. In this it does not differ greatly from many other discussions of the subject. This chapter includes good discussions of mixing, conveying and depositing concrete; the importance of proper methods of curing concrete; the safeguarding of desirable properties of good concrete, such as density and impermeability; and the effect of oils, acids and alkalies on concrete.

The author has properly included in the text and in the 16 appendices a large amount of accurate information from other authorities and sources, thereby saving the reader a large amount of cross reference work. In this legitimate borrowing he has been scrupulous to give proper credit, with the unfortunate result in some instances, however, of giving honor to other writers for material that they had themselves borrowed without like consideration to the real originators.

I can heartily commend this book to those seeking a text for beginners and I believe that the experienced workman in the design and construction of reinforced-concrete buildings will find in the book sufficient new material and old material presented in a better way, to make it a real addition to the steady-reference library.

A Notable Autobiography

BENJAMIN GARVER LAMME, ELECTRICAL ENGINEER: An Autobiography. New York and London: G. P. Putnam's Sons. Cloth; 6x9 in.; pp. 271; many halftones. $3.

Writing the history of modern times means writing of the development of science, technology, and commerce rather than of dynasties and empires. The professional historians probably will write some of its chapters, but the essential parts of the story are so complex and specialized that they can be recounted truly only by those who were living parts of the development. The history source books of the future will not be secret state papers and treaties but records of the work of leaders in industry. B. G. Lamme's posthumous autobiography is one of the first of these important documents to be written.

It is a book of remarkable importance—and equal human interest. Lamme came to the Westinghouse Electric Co. very soon after its beginning, in the era of series arc-lighting and the first street railways; he remained there during his entire career, to the time of the present-day huge steam-turbine polyphase generators and great industrial-power motors. In his whole lifetime he was directly concerned with exploring the unknown action of generators and motors, developing new machines, and pushing forward the frontier of the electrical art. His book is a condensed, business-like running account of that long and brilliant life of activity, and yet, because of the clearness with which he saw and wrote, it is wonderfully detailed and informing. Neither electrical history-writing nor electrical education henceforth can do without using Lamme's story as a manual.

Its human interest, no less outstanding, will probably be found in different elements of the book, according to the reader's leanings. To the reviewer it lies in the impressive procession of men of the electrical art that passes through its pages, rather than in the author's self-reveal-

ment. So objective a mind as Lamme's inevitably wrote objectively—looking outward and reporting—and what he presents to the reader is a photograph, a moving picture. As to the camera, the man himself, we can only guess. True, we learn that he devised and patented a magic-square puzzle, that he longed until his death for a visit to the isles of Greece, and that he wrote technical articles slowly and found it very difficult to make them as clear as he wished; but a few fragments of fact such as these are not enough to reconstruct the great engineer whose insight, analytical powers and tremendous capacity for work helped to build the electric power art as it turns the world's wheels today.

If the reader feels any lack on finishing the book, it lies in the fact that Lamme's story after all is only part of a much greater activity, which could hardly be seen from one viewpoint or told by one man. Were it possible to accompany his own story with annotations, equally full, and written from as thorough knowledge and a view as objective, its historical importance would be even greater.

Elevator Design and Operation

ELECTRIC ELEVATORS: Their Design, Construction, Operation and Maintenance—By F. A. Annett, Assistant Editor, *Power*, M. A.I.E.E., Author of "Electrical Machinery." New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 447. 351 line cuts and halftones, 3 insert plates. $5.

Few classes of equipment are as essential to modern buildings as are elevators. Consequently, although civil engineers interested in the design, construction or maintenance of large buildings may assume at first glance that a book entitled Electric Elevators has little of interest to them, yet they will find upon inspection that this one contains much of real value. Engineers who design or build will be able to learn much from it of the characteristics of various types of elevators and control systems and also as to power requirements. But it is chiefly engineers responsible for the maintenance of elevators that will find the book of value. Not only is considerable space devoted to methods for detecting faults in motors and mechanical equipment and to instructions as to lubrication, but there also is much on the subject of the construction and care of cables and on methods for replacing worn out cables.

Of Value to Engineers

ECONOMIC PROBLEMS OF MODERN LIFE—By S. Howard Patterson, A.M., Ph.D., and Karl W. H. Scholz, A.M., Ph., D., both Professors of Economics, Wharton School of Finance and Commerce, University of Pennsylvania. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 615. $3.

Here is a text on economics that is neither abstract nor philosophical. Nor is it controversial or propagandist. And in these negative qualities lies its greatest value to the engineer reader.

It is fairly obvious today that the engineer can grow into a more significant position in the affairs of the community only through a more intelligent and comprehensive grasp of economic processes. But this is not easily acquired. Certainly it is not easily to be derived from the conventional presentation of economic theory and principle. As an exercise in pure science all this may serve an admirable purpose but the mechanism of application to modern life is too involved and the average engineer is too vaguely acquainted with its structure and operation. The conventional study of economics is too much like studying thermodynamics without ever having seen a heat engine.

So the authors have reversed the ordinary process, setting forth to begin with the outstanding and practical economic problems of the day, then developing through their analysis the principles that are involved. These various problems they marshal in five groups: Problems of Economic Organization, of Monopoly, of Exchange, of Public Finance and of Labor and Industrial Unrest. Each problem is stated clearly and analyzed in a separate chapter which includes also a brief discussion of the chief current theories as to its origin and best solution.

Any engineer who will read thoughtfully these succinct discussions will be in far better position than the average to understand what is going on around him in the world of business and with respect to the economic aspects of government. He will receive, in effect, an intensive course in modern applied economics.

The Explosives Industry

HISTORY OF THE EXPLOSIVES INDUSTRY IN AMERICA—By Arthur Pine Van Gelder and Hugo Schlatter; with an Introduction by Dr. Charles E. Munroe. [Prepared from Data Collected by and Published under the Direction of the Institute of Makers of Explosives.] New York: Columbia University Press. Cloth; 6x10 in.; pp. 1132; 432 halftones. $10.

Combining history, biography and trade development with a modicum of description of the technic of explosives manufacture and use, the compilers of this volume have produced a notably readable book despite its formidable size. It is needless, perhaps, to state that the lay reader alone will find instruction in the technical portions, and the biography, with numerous portraits, will naturally mostly interest those engaged in the explosives trade, but in the historical parts anyone, and particularly the engineer and contractor, can find much that is interesting and educative. All the first six chapters on the history of gunpowder until the end of the Civil War and the following six chapters on the early powder makers are worth perusal. These twelve chapters make up part one. Then comes part two on nitroglycerine and dynamite with nine chapters; part three on blasting supplies; part four on smokeless powders, with thirteen chapters; part five on military explosives, and part six on explosives in the making of America. Produced by a trade association the book naturally reflects its origin by exploiting the industry, its leading men and its usefulness, but there is much to which the student and the user of explosives can turn and receive help. They may well keep in mind that the book may be found on the library shelves.

Bridges of the World

BRIDGE ARCHITECTURE: Containing Two Hundred Illustrations of the Notable Bridges of the World, Ancient and Modern, with Descriptive, Historical and Legendary Text—By Wilbur J. Watson. New York: William Helburn, Inc., (15 East 55th St.). Board and cloth; 11 x 15 in.; pp. 288; 199 (mostly full-page) halftone plates and some line drawings and halftones in text. $17.50.

A historical account of many of the fine bridges of the world supported by 200 unusual halftone illustrations is contained in Mr. Watson's "Architectural Bridges." General data and dimensions are given for each bridge and throughout the text runs the author's argument that "the best interests of the bridge architecture can be served in the future through the close co-operation of the architect and the engineer."

The contents of the book are arranged into six historical periods—the Ancient Period preceding the Roman

era, the Roman period from 300 B.C. to 300 A.D., the Middle Ages from the 11th to the 16th century, the Renaissance during the 16th and 17th centuries, the Eighteenth Century and the Modern Period. The characteristics of each period and of many specific bridges therein are considered both with regard to type of structure—arch, beam, suspension, cantilever and truss—and to the training and education of the designers.

It is a book that should prove as interesting to the lay reader as it is interesting and informative to the architectural and engineering professions. The illustrations alone will make a valuable addition to anyone's library.

City and Industrial Health Problems

CITY HEALTH ADMINISTRATION—By Carl E. McCombs, M.D., National Institute of Public Administration and New York Bureau of Municipal Research. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 524. $5.50.

WORKERS' HEALTH AND SAFETY: A STATISTICAL PROGRAM—By Robert Morse Woodbury; With the Aid of the Council and Staff of the Institute of Economics. [Institute of Economics Series: Investigations in Industry and Labor.] New York: The Macmillan Co. Cloth; 5x8 in.; pp. 207. $2.50.

The diversity and intensity of current studies of health problems is well illustrated by these two books, one devoted to the broad field of city health administration and the other to the health and safety of industrial workers. The first book approaches the subject as a branch of municipal government; the second from the statistical viewpoint, to determine what data are needed to reduce industrial accidents and promote the health of industrial workers, in each case taking insurance into account. Each is an admirable study in its field.

Dr. McComb's volume is in three main parts: (1) Municipal Health Functions and (2) and (3) The Organization and Administration of Sickness Preventive and of Sickness Treatment Functions. The first part presents health-protective work in its relation to municipal administration as a whole, taking into account the various types of charter, as commission and commission-manager. Weaknesses of boards of health are enumerated, particularly those resulting from the attempt to carry on executive functions through a group rather than an individual. The latter method is preferred by the author. Under sickness prevention, among other things, the various communicable diseases are considered. Sickness treatment has to do with hospitalization. The volume contains a large amount of well digested material, chosen and presented primarily to meet the needs of students of municipal administration.

A Widely Useful Book Catalog

A. L. A. CATALOG 1926: An Annotated Basic List of 10,000 Books—Edited by Isabella M. Cooper. Chicago: American Library Association. Cloth; 8x10 in.; pp. 1,295. $6.

Although intended primarily for public library use, anyone concerned with building up a library, even though of only a few hundred volumes, would find this catalog useful. The ten thousand entries are grouped under the ten main divisions of the Dewey decimal classification, two of which are Natural Science and Applied Science. Engineering comes in the second of these, with 227 entries, not including the many allied books under communication, chemical technology, manufactures, mechanic trades and building. Landscape gardening and architecture together have 162 entries, under Fine Arts. Statistics, economics, law, government and other topics of importance to many engineers are well represented under Sociology. The notes to each entry give a good idea of the nature of each volume and the class of readers to which it is suited. Publishers, sale prices, detailed catalog entries and Library of Congress catalog card numbers are given—copies of these cards may be ordered from Washington.

To make the contents of the catalog thoroughly accessible, there is an author, title and subject index (368 pp.). Finally, there is a directory of publishers, both American and foreign, with street addresses.

Among the uses to which this remarkable catalog may be put, as the editorial preface indicates, are: as a guide to book buyers and readers; to take the place of a printed catalog in small public libraries; and by anyone as a check list of books owned or read.

Oil As a Lubricant

LUBRICATION AND LUBRICANTS: A Treatise on the Theory and Practice of Lubrication, and of the Nature, Properties and Testing of Lubricants—By Leonard Archbutt, F.I.C., F.C.S., Past-President of the Society of Public Analysts and Other Analytical Chemists; formerly Chemist to Midland Railway Co.; and R. Mountford Deeley, M.Inst.C.E., M.I.Mech.E., F.G.S., formerly Locomotive Superintendent, Midland Railway. Fifth Edition (revised throughout, greatly enlarged, reset). London: Charles Griffith & Co.; Philadelphia: J. B. Lippincott Co. Cloth; 6x9 in.; pp. 650; 272 halftones and line cuts. $15.

So much has been learned of the chemical and physical properties of oil since the fourth edition of this remarkable work was published in 1912 that the authors found it necessary to enlarge the volume considerably and to revise the old text extensively in preparing a new edition. Two chapters are given over almost entirely to a discussion of the results of recent research which make a new edition desirable and much new material has been added to other chapters.

A review of the chapter headings is the best summary of the book's contents. Introductory chapters deal with the problem of lubrication, thin films and surface forces and the friction of clean, solid surfaces and surfaces covered by absorbed films. Following chapters deal with internal friction or viscosity of liquids, the theory of viscous lubrication, and plastic friction. Coming down to the lubricants themselves there is a chapter upon their sources and chief properties, subdivided into the various classes, chief of which are mineral, fatty oils and fats, greases and solid lubricants. Subsequent chapters deal with the physical and chemical properties and the methods of examination of lubricants as well as methods of testing lubricants and bearing metals. Chapters dealing directly with lubrication include those on appliances for lubrication, composition, design and lubrication of bearings, surface ball and roller, the lubrication of engines and machines and the management of machinery, and the clarification and recovery of used lubricating oils.

A review of the second edition of this book appeared in *Engineering News*, Dec. 12, 1907.

City Map of Greensboro

REPORT OF THE GEODETIC, TOPOGRAPHIC AND BLOCK SURVEY of Greensboro, North Carolina [P. C. Painter, City Manager, T. K. Roberts, Engineer of Zoning and City Plan]—By R. H. Randall & Co., Geodetic and Topographic Engineers, Toledo, Ohio. Paper; 6x9 in.; pp. 125; folding map of Greensboro, and map in pocket.

Too much emphasis cannot be placed upon the necessity for municipal authorities' acquiring accurate and complete map data within incorporated limits. What the lack of such data means is well explained by P. C. Painter, city manager of Greensboro, N. C., a map of which municipality has recently been made following the

best practice of precise geodetic control. In transmitting this map, which was made by a private corporation, to the mayor and city council of Greensboro, Mr. Painter said: "Until this map was made, Greensboro was building a city without a plan of the site, a method just as costly proportionately in mistakes as attempting to construct a great building without a plan." The complete survey comprises a geodetic survey, block survey, topographic survey and the preparation of a city street map for wall and desk use. The geodetic survey consisted in triangulation to control the precise traverse and other horizontal surveys, the precise traverse and precise levels. The block survey comprised location of all street corner intersections, a block survey traverse and a block survey map on a scale of 1 in. to 100 ft. The topographic survey consisted in secondary traverse and levels, topography on the scale of 1 in. to 200 ft. of the entire city and adjacent areas and the reproduction of topographic maps in three colors. Co-operation in the preparation of these data was had from the city's engineering staff and private engineers, the latter particularly having information otherwise unobtainable on early block surveys.

British Road Construction

THE SCIENCE OF ROADMAKING: A Scientific and Practical Treatise dealing with Road Construction in its modern forms, for the use of Surveyors, Contractors, Asphalt Plant Managers, etc. —By John Wilfrid Green, M.Inst. Mun. & Co. E., M.R.San.I., A.M.Inst. Transport, City Engineer and Surveyor, Durham; and Charles Norman Ridley, F.C.S., Technical Chemist. London (England): Crosby, Lockwood & Son. Cloth; 6x9 in.; pp. 138; 4 halftones, 1 chart. 10½ shillings.

Compared with the books of his own writers on highway construction, the American road engineer will find this volume brief and elementary. It reflects British practice exclusively. The subjects discussed are: Hydrocarbons, bitumens, asphalt, sandfiller, tar and pitch, tarmacadam, stone sett paving, wood block paving, cement and concrete, concrete roads, tar and bitumen tests and cement and concrete tests. Rarely does the treatment go beyond the elementary text-book stage.

Publications Received

FIVE DOLLARS is the price of the Final Report of the Board of Engineers of the Delaware River Joint Commission, noted in this section, Aug. 18, 1927, p. 277. Orders should be sent to the Enterprise Publishing Co., Burlington, N. J.

THE EFFECT OF LIME ON SLUDGE DIGESTION is the main topic presented in the 1925-26 Report of the Sewage Substation, New Jersey Agricultural Experiment Station, New Brunswick, N. J., Willem Rudolfs, director. Film accumulation in sprinkling filters and protozoa in Imhoff tanks are also considered.

A COMPREHENSIVE REPORT containing many illustrations and tables showing the condition and progress of the improvements made at the mouth of the river and in the harbor of Bilboa, also receipts and disbursements during 1926, has been published (in Spanish) by the harbor authorities of that city (Obras de Mejora de la Ria y Puerto de Bilboa, Spain).

THE RAILWAY TIE SUPPLY PROBLEM, in its practical and economic aspects, is discussed from the producers' point of view in the 100-p. annual *Proceedings* of the National Association of Railroad Tie Producers (secretary, Roy M. Edmonds, 1244 Syndicate Trust Building, St. Louis, Mo.). Both domestic and foreign sources of supply are considered in the papers and reports.

NINE-HUNDRED AND NINETY-NINE Industrial Research Laboratories of the United States are listed, their staff given and lines of work stated in the third edition of the directory compiled for the National Research Council, B and 21st Sts., Washington, D. C. ($1). Besides the alphabetical list, there are given separately the addresses of directors of research, the geographical distribution of laboratories and a subject classification of laboratories.

THE CONTRACTOR'S STORY OF THE MOFFAT TUNNEL is a handsome 59-p. profusely illustrated and semi-technical description of the construction methods and progress records of this 6-mile railroad tunnel through the Rocky Mountains at the continental divide (Hitchcock & Tinkler, Inc., contractors, Denver, Colo., and New York). While geologists predicted only about 1,500 ft. of material requiring timbering, the actual timbered length was nearly four miles and the authors say: "A new work must be written on the geology of the Rocky Mountains, and the contractors would like to compose one paragraph."

TESTS of two distinct classes of tapes—the steel tapes used in ordinary surveying and verification of the more precise tapes used in geodesy—are described in Testing of Measuring Tapes at the Bureau of Standards. All tape testing is done in a special underground laboratory, a room 170 ft. long and 7 ft. wide, provided with brine coils and with steam pipes, so that a range in temperature from 8 to 35 deg. C. may be obtained. The usual tests for sag, expansion and tension are applied to the standard tapes. For testing tapes used in geodetic work much more complicated methods are used, too extensive to note here. (10c. from Superintendent of Documents, Washington, D. C.)

ELECTRIFICATION of the city and suburban railways of Sydney, New South Wales (with 400 miles of track), is presented in a 375-p. volume (Railway Commissioners of New South Wales, Sydney, Australia). It is a reprint of a series of papers presented before the Institution of Engineers of Australia, as follows: "The Railway System of Sydney," by James Fraser, chief railway commissioner; "Track and Construction Work," Robert L. Ranken, engineer in chief; "The Signaling System," C. B. Byles, signal engineer; "Electric Rolling Stock and Shops," Ernest E. Lucy, chief mechanical engineer; "Power Supply and Distribution," Harold Myers, chief electrical engineer; "The City Railway," John J. C. Bradfield, chief engineer of Metropolitan Railway construction.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

BETRIEBSERGEBNISSE DER SCHLAMM-BELEBUNGS-ANLAGE des Ruhrverbands in Essen-Rellinghausen—Von Dr.-Ing. Imhoff, Ing. Fries und Dr. Sierp, Essen. Reprint from *Technischen Gemeindeblatt*. Paper; 5x8 in.; pp. 20; 8 halftones, 7 line cuts. For copies, apply to Dr. Karl Imhoff, Chief Engineer, Ruhrverband, Essen, Germany.
Description and operating results of activated-sludge plant at Essen-Rellinghausen, Germany [*Engineering News-Record* of Aug. 19, 1926, p. 298, contained briefer description]. Special features are oil-skimming basin, wood paddles as well as air agitation for activation, and heating with own gases of separate sludge digestion chamber.

DAILY RIVER STAGES AT RIVER GAGE STATIONS ON THE PRINCIPAL RIVERS OF THE UNITED STATES, Vol. XXIV for the Year 1926—By H. C. Frankenfield. [W. B. 920. Washington, D. C.: U. S. Weather Bureau.] Paper; 9x12 in.; pp. 185; tabulated matter.

ENGINEERING PROBLEMS MANUAL—By Forest C. Dana, Professor of Engineering Problems, Iowa State College; and Elmer H. Willmarth, Assistant Professor of Engineering Problems, Iowa State College. New York and London: McGraw-Hill Book Co., Inc. Cloth; 5x8 in.; pp. 187; drawings, and mathematical tables. $2.

MANUFACTURE AND USES OF CONCRETE PRODUCTS AND CAST STONE—By H. L. Childs, Editor, Concrete Publications, Ltd. London: Concrete Publications, Ltd. (20 Dartmouth St., Westminster, S.W.1.). Cloth; 6x9 in.; pp. 193; 147 halftones and line cuts. 5s., net.

REPORT OF AN INVESTIGATION OF THE POLLUTION of Lake Michigan, in the Vicinity of South Chicago and the Calumet and Indiana Harbors, 1924-1925—By H. R. Crohurst, Sanitary Engineer, and M. V. Veldee, Passed Assistant Surgeon, United States Public Health Service; in Co-operation with the Sanitary District of Chicago, Chicago City Department of Health, Indiana State Board of Health, and Illinois State Department of Health. [Public Health Bulletin 170, April, 1927.] Treasury Department, United States Public Health Service. Washington, D. C.: Government Printing Office. Paper; 6x9 in.; pp. 133; 25 diagrams and charts, 2 insert maps, many tables.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Wood Stave Outfall Sewer at El Paso

Sir—The article by Robert P. Anderson, city engineer, El Paso, Texas, on "Replacing Wood Stave Outfall Sewer with Concrete at El Paso," in *Engineering News-Record*, Aug. 4, 1927, p. 175, gives the impression that wood stave pipe has failed and that readers of the article should be warned against that type of structure. I feel quite sure that neither the writer of the article nor the writer of the headlines had any such intention.

The pipe was either intended for temporary use or else was designed by an engineer not familiar with the use of wood stave pipe for sewage outfalls. It was made of a wood that we have reason to believe cannot be expected to make proper pipe. The wood was untreated and therefore its life would equal an ordinary piece of wood placed under most harmful conditions. It was alternately wet and dry and constantly subjected to acids, gases, and matter most deleterious to any wood. It could not have been expected that this line would last more than three or four years. Possibly a concrete pipe with aggregates improperly proportioned, poorly mixed, and badly laid would not have lasted any longer.

Fortunately other localities have had better success with outfall sewers made of wood. In all cases the timber is Douglas fir. The staves are creosoted by the pressure and vacuum process as described in the *Proceedings* of American Wood Preservers Association, 1922, pp. 258 and 262. Most important of these installations are the following:

At Redondo Beach, for the city of Los Angeles, is a 54-in. sewer outfall extending out over the ocean. In this instance the bands and shoes, or lugs, were galvanized as a protection against sea water. San Francisco Bay has numerous wood pipe outfall sewers. Portland, Ore., has three lines, a 45-, a 60- and an 88-in., all extending into or over the Willamette River. Seattle has several such sewer outfalls, the principal one being 60 in. in diameter, discharging into Lake Washington. These outfalls are from 5 to 15 years old. A recent examination of several of them shows no signs of deterioration.

A pipe most worthy of note was constructed of creosoted Douglas fir in 1902 in the city of Everett, Wash. It carries salt water from Puget Sound. It is alternately wet and dry and, some years ago, was partly covered with garbage and other refuse. No more deleterious conditions could be imagined, yet the pipe today, after 25 years, is perfectly sound and apparently ready to begin another quarter century of service.

The object of this letter is to show that a wood pipe outfall sewer, *per se*, is not a failure unless it be of faulty design and constructed of improper materials and also to bring out the point that headlines may sometimes be misleading and harmful to established industry.

H. D. Coale,
Chief Engineer, Federal Pipe and Tank Co.

Seattle, Wash.,
Aug. 12, 1927.

Sir—My article was in no way intended to deprecate the use of wood stave pipe in general, as I am fully aware that wood stave pipe, under proper conditions and designed and built under proper engineering superintendence has proved very satisfactory and lasting. Primarily, the article intended to set forth the construction methods used under the unusual conditions encountered. The paragraph referring to the disintegration of the wood pipe was intended only to show what did happen and what might be expected of this class of pipe when it is built of unsuitable material and improperly placed.

Mr. Coale is correct in assuming that the pipe in question was intended for temporary use only. A review of the construction records of the sewage disposal plant shows that the funds appropriated for the entire project were nearly exhausted when it was found necessary to provide a new outfall. A hasty design for a temporary structure, using a local material, was made that would come within the limits of the available funds.

Had this wood stave pipe line been made of the proper material, properly treated to withstand the alternate wetting and drying on the outside, and had proper precautions been taken against the gas pockets on the inside, I have no doubt but that it would still be giving good service with a reasonable life still ahead of it. However, I am of the opinion that wood stave pipe is not suitable under all climatic and other given conditions and in this particular case, I think that the concrete installation will prove superior and more permanent than wood stave construction.

In conclusion, let me again state that it was never intended by the writer to give the impression that all wood stave pipe outfalls are failures, or in any way to injure this established industry. I trust that, in general, readers have not gained such an impression. I am indebted to Mr. Coale for calling this possible interpretation to my attention so that it might be corrected in the column.

Robert P. Anderson,
Now Construction Engineer, Ware Co.,
Formerly City Engineer, El Paso.

El Paso, Texas.
Sept. 3, 1927.

Pavement Crown Formula

Sir—In your issue of July 28, 1927, p. 152, Ernest S. Ross advocated using a pavement cross-section having one-third the drop at the quarter point. The formula given for this is $y = x^{1.58497}$. We have used this cross-section in New Bedford, but have found it convenient to deviate a trifle further in the same direction from the parabola formula and use $y = x^{1.5}$; or $y = x^{3/2}$. This varies from the other to the extent of giving about 35/100 of the drop at the quarter point instead of 1/3. It has a practical advantage when used for giving grades for manhole covers or castings at odd distances from the crown point, in that the required figures can be quickly obtained from a slide rule.

L. J. Hathaway, Jr.,
Assistant Engineer, City Engineer's Office.

New Bedford, Mass.,
Aug. 27, 1927.

Usefulness of Pondage Factor in Spillway Design

Sir—In the article entitled "Pondage an Important Factor in Spillway Design" by Melville D. Casler in *Engineering News-Record*, July 28, 1927, p. 133, the first, or graphical method, is almost exactly the same as a method published by myself in *Engineering News* in March, 1912. It has been used several times since then in making investigations of dams for storage and flood control; and the spillway of the Coolidge dam, now in course of construction near San Carlos, Ariz., was designed by means of it.

It is such a flexible method of design that it can also be used to determine the regulating effect of an orifice under pressure, either alone or in conjunction with a spillway.

Considerable calculation can be saved in making the trials by substituting planimeter readings of the shaded area of Fig. 3 for S (storage in billion cubic feet) in Fig. 1, and in making the ordinate of this curve correspond to the weir discharge per foot of weir. The first change is easily made once the scale of the figure is determined and saves a needless duplication of the reduction from planimeter readings to billion cubic feet for every trial. The second change is made so that one curve will suffice for any length of weir, as it is often necessary to compute several different sizes before a satisfactory one is found.

H. K. Palmer.

Los Angeles, Calif.,
Aug. 24, 1927.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Contract Let for $10,000,000 Dam On the River Nile

Structure 2,875 Ft. Long to Consist of 99 Piers to Form Support for 100 Sluice Gates

CONTRACT for the construction of another dam across the Nile River in Egypt 367 miles above Cairo has been let to the firm of Sir John Jackson, Ltd., of London, and work will be undertaken at once, according to *The Engineer*, London. The dam, more properly called a control weir or barrage, will consist of a masonry floor 194 ft. wide extending across the entire width of the stream, surmounted by 99 masonry piers forming the support for 100 sluice gates to control the flow of the river. This is the usual type of barrage used in the regulation and control of the Nile River. It presents little obstruction to the flow of the river or the movement of silt when open. The total length of the structure is 2,875 ft., made up almost entirely of the piers and openings except for a canal lock at one side.

The floor across the river bottom is to be built of concrete with a surface of dressed stone, rubble masonry, and concrete blocks. Its maximum thickness will be slightly over 9 ft. Two continuous single rows of sheetpiling under the floor and one double row with concrete between will form the cut-off against underflow. The level of the floor will be as close as possible to that of the river bottom, largely all at one level with two short sections at lower levels. The piers are to be of limestone rubble masonry faced with dressed granite or limestone, generally about 6½ ft. thick by 62 ft. long. The gate openings are about 20 ft. wide. The piers are to be surmounted by masonry arches supporting a roadway and tramway for the power-driven machines for operating the roller type sluice gates.

Engineers for the Egyptian Government on this work are the firm of Coode, Fitzmaurice, Wilson & Mitchell, of London. The engineers' estimates of the work were £1,999,000, and the contract price is £1,976,555.

New York State Grade Crossing Conference Called

A conference between the presidents of the 43 railroads operating in New York State and the governor of the state on the subject of grade-crossing elimination has been called by Governor Smith of New York State for Oct. 10. The provisions of the $300,000,000 grade-crossing elimination act have been found to work hardship upon some of the smaller communities, and Governor Smith is anxious to get the co-operation of the railroads in a plan to get around such difficulties.

Brief News

HEARINGS ON PLANS FOR MODIFICATION OF THE PIERHEAD LINE of the Hudson River will be held by the War Department, in the Army building, 39 Whitehall St., New York City, Sept. 30, at 10:30 a.m. The plans submitted by the Department of Docks, which is the applicant, show modification of the existing U. S. pierhead line on the easterly side of the Hudson River between West 30th and West 72d Sts.

THE THIRTEENTH DAMAGE SUIT against the federal government resulting from the sinking of the steamer Norman (see *Engineering News-Record* May 14, 1925, p. 827 and May 21, p. 855) has been filed in the district federal court at Memphis, Tenn. The plaintiff is H. J. Simonson, father of Earl Simonson, who, as a fireman, was drowned when the Norman sunk. Other suits have been filed by widows of several civil engineers who also were drowned at the same time.

WORK WAS BEGUN IN AUGUST on the Lancha Plana dam on the Mokelumne River in California subsequent to a court decision favoring the East Bay Municipal Utility District. Contract for this dam was awarded two years ago (see *Engineering News-Record*, Oct. 8, 1925, p. 698) but authority to start work has been withheld pending the outcome of court proceedings over land and rights-of-way.

BIDS HAVE BEEN CALLED by the British Columbia Electric Ry. for boring the 2½-mile tunnel to be constructed in connection with the company's new hydro-electric development project at Bridge River. The tunnel will have a diameter of 13 ft. and will extend from Seaton Lake to Bridge River through Mission Mountain Range. Boring of the tunnel will be the first stage in construction of the project, the initial development of which will cost about $13,000,000. The power plan will add almost 625,000 hp. to the resources of company on the lower mainland. The first two units completed will add 60,000 hp. to Vancouver's power supply. The current will be brought into Vancouver on a new high potential line crossing Burrard Inlet at Second Narrows.

Chicago Scored by Chief of Engineers on Metering Laxity

Modification of 1925 Permit Sought —City 16 Per Cent Behind Federal Schedule

CHICAGO'S failure to meter its water supply in accordance with clause 8 of the War Department's permit of 1925 to divert 8,500 sec.-ft. of water from Lake Michigan to the Chicago Drainage Canal was pointed out emphatically by Major General Edgar Jadwin, Chief of Engineers, U. S. Army, to the members of the committee on finance of the Chicago City Council who visited him last week in regard to the proposed ordinance substituting water-waste prevention for universal metering. Although the permit of 1925 was conditioned on the metering of 9 per cent of the services annually the city so far has metered only 2 per cent during the past two years. As to water-waste prevention, that should be undertaken by the city in its own interests, but the War Department is concerned neither with that nor with the class of services to be metered. The War Department is concerned only in having the city live up to its agreement to meter 9 per cent of the services annually until 90 per cent of all services are metered.

The delegation requested information under three heads: "Why the universal meterization of its water supply to its consumers is not a local question. 2. Why the city's consumption of about 1,200 sec.-ft. should be coupled with the Sanitary District's permit for withdrawing 8,500 sec.-ft. when such 1,200 sec.-ft. is not included within the amount. 3. Will the War Department modify clause 8 of the Sanitary District's permit if the Chicago City Council should adopt the substitute ordinance for the universal metering ordinance that Harry Biosatt has discussed with the Department, and the details of which are embodied in the petition forwarded to the War Department by Commissioner of Public Works Richard W. Wolfe, under date of Sept. 2, 1927."

CONTROVERSY REVIEWED

In his reply to these questions General Jadwin reviewed the controversy over diversion of the past 17 years, and the Supreme Court decision in 1925 that the city (or district) has no right to divert water to the extent that it had been doing, and that an injunction against the diversion would be issued unless the War Department granted a

(*Concluded on p. 447*)

Twenty Bids Received on Approach Contracts for Port Authority Bridges

Twenty bids were received on Sept. 12 by the Port of New York Authority on the four plaza and approach contracts for the Arthur Kill bridges between Staten Island and New Jersey. The Tottenville contract will require some 680,000 lb. of reinforced steel and 38,000 cu.yd. of embankment; the Perth Amboy contract 110,000 lb. of steel and 4,000 yd. of embankment; the Elizabeth contract 220,000 lb. of steel and 6,000 yd. of embankment; and the Howland Hook contract, 140,000 lb. of steel and 24,000 yd. of embankment. The twenty bids received follow:

TOTTENVILLE: W. H. Gahagan, Inc., of Brooklyn, $226,737.50; John E. Brady Corporation, of New York, $249,143; O'Neill Co., of Newark, $255,982.50; Frederick Snare Corporation, of New York, $263,910; Albert A. Volk Co., of New York, $268,960; Staub & Koylin Construction Co., of Trenton, $371,560.

PERTH AMBOY: T. J. M. Contracting Co., of New Brunswick, N. J. $38,214; W. H. Gahagan, Inc., of Brooklyn, $38,667.50; O'Neill Co., of Newark, $40,300; Triest Contracting Corporation, of New York, $53,640; Staub & Koylin Construction Co., of Trenton, $64,140; Little & Pfeiffer, of Perth Amboy, $75,611.50.

ELIZABETH: O'Neill Co. of Newark, $77,825; Triest Contracting Corporation, of New York, $80,970; Elizabeth Paving Co., of Elizabeth, $96,130; Bentley-Morrison Corporation, of Elizabeth, $116,249.

HOWLAND HOOK: O'Neill Co., of Newark, $94,360; Frederick Snare Corporation, of New York, $98,615; John E. Brady Corporation, of New York, $98,811; W. H. Gahagan, Inc., of Brooklyn, $103,665.

Two More Freeman Fellowship Awards Are Made

The American Society of Mechanical Engineers announce the award of two traveling fellowships to Herbert N. Eaton of the Bureau of Standards at Washington and Blake R. Vanleer, professor of mechanical engineering in the University of California, Berkeley, Calif. These awards are made possible through the generosity of John R. Freeman, of Providence, R. I., past-president of the American Society of Mechanical Engineers and the American Society of Civil Engineers. Mr. Freeman created a fund providing for the study of flood prevention and for the sending of two or more men every two years to Europe to spend a year in study and engineering research on subjects which will be of direct benefit to the development of our country as well as to the promotion of engineering practice. This year, in order to make a definite contribution in the national emergency created by the overflow of the Mississippi River, Mr. Freeman has made it possible for the A. S. M. E. to send two men to make an exhaustive study of hydraulics instead of one man as would customarily be the case.

Mr. Eaton has been employed by the Bureau of Standards in Washington since the time the United States entered the World War. During this period, while he was not engaged in hydraulic work, he spent considerable time in the study of aeronautical instruments. He has had exceptionally fine experience with measuring instruments, particularly instruments for measuring pressures and velocities.

Following his graduation from Purdue, Prof. Vanleer was chosen as assistant professor in mechanical engineering at the University of California. When the United States entered the World War in 1917, he enlisted in the engineer corps, served overseas, being promoted to the rank of captain.

Engineering Fifty Years Ago

From *Engineering News*, Sept. 15, 1877

WORK upon the tunnel under the Hudson River between Jersey City and New York, which has been delayed for some time by litigation, it is now stated will be resumed early in the fall. A shaft 28 ft. deep has been dug at the foot of Fifteenth St., Jersey City, and this depth will be increased twenty feet. From this as a starting point the tunnel will proceed in a northeasterly direction under the Hudson River and the Christopher Street ferry slip. The entrance on the New York side will be in the neighborhood of Washington Square. From Jersey City the grade will descend 2 ft. in every 100 ft., until a point 2,700 ft. from the New York side is reached, when it will begin to ascend at the rate of 1 ft. in every 100 ft. The tunnel will be two miles in length, with a roadbed 23 ft. wide, and two separate tracks. Through its entire length it will be lighted by gas. The wall will be constructed of brick, with a thickness of 4 ft. At no point will the top of the tunnel be less than 35 ft. below the surface of the water, and in many places it will be 70 ft. below. One hundred and twenty laborers will be engaged in the construction of the tunnel. The work will go on during the whole of the twenty-four hours, the force working in three relays, of eight hours each. Although the tunnel will be used for the conveyance of passengers, its main object will be the transportation of freight to and from the great railroad lines which terminate in Jersey City. The capital of the company is $10,000,000.

Road Builders' Association Sponsors Prize Competition To Promote Traffic Safety

Prizes totaling $1,000 are offered by the American Road Builders' Association for the best ideas for reducing the number of highway accidents occurring each year. The contest, which is being held in connection with a national safety campaign, is open to everyone. It will close midnight, Nov. 15.

More than 114,000 persons have been killed and nearly three and a half million injured during the past five years as a result of highway accidents, the association stated in explaining the need of such a campaign. Last year the accident toll was 25,302 killed and 759,060 injured, and the economic loss resulting from accidents was $638,875,500. The figures have been mounting steadily for five years.

First prize in the contest is $500. There will be nine other prizes, totaling $500. The awards are offered for "the best workable plan that will decrease street and highway accidents. The plan," the association explains, "may be a complete comprehensive thesis covering the entire subject or a mere description of a single idea that would contribute to highway safety. The plan must be practical and capable of being put into operation at reasonable expense."

Winners will be announced Jan. 11, 1928, during the annual convention and road show of the association in Cleveland January 9-13. A report compiled from the ideas submitted for the contest will be presented to the convention.

C. C. N. Y. Announces Night Course in Building Construction

Evening courses in building construction again are to be offered by the College of the City of New York, School of Technology, beginning with the opening of the college year. These courses, though organized in 1920, have been somewhat extended and have been offered as the result of a very pressing need for such evening instruction. Every effort is made to make the instruction as thorough as possible and at the same time considerable stress is laid on the practical application of the subject matter taught in each course. Courses offered include inspection of materials of building construction, plan reading and estimating, engineering design, architectural engineering, reinforced concrete—its theory and practice, advanced estimating and specifications and advanced plan reading, drafting, use of surveying instruments, plumbing equipment, estimating and specifications, heating and ventilating of buildings, planning, design and construction of suburban houses and of tenement houses, architectural design, practical reinforced-concrete building design, reinforced-concrete construction and estimating, and structural steel drafting and detailing.

California Appropriates $600,000 Additional for Convict Highway Labor

The California legislature this year appropriated $600,000 for the payment of wages to convicts employed on the construction of state highways and at the same time authorized the board of prison directors to assign an additional $100,000 for the same purpose from funds available for the support of convicts in the state prisons. A total of 290 prisoners are now employed on state road construction and with the funds just made available, an average of 500 convicts could be employed continuously throughout the 2-year period. A review of California's experience with convicts on road work was published in *Engineering News-Record*, Feb. 10, 1927, p. 241.

The California law allows each prisoner pay for roadwork not to exceed $2.50 per day out of which must be paid each man's share of the entire cost of camp maintenance including clothing, medical attention, rewards for recapture of escaped prisoners, etc. The Highway Commission pays for free labor that is necessary in conjunction with convict road camps, equipment rental, construction materials, etc. In the coming biennium the Highway Commission expects its portion of the convict roadwork expense to be about $1,500,000. Partly because this money will not be available for a few months and partly because surveys and plans for the work are yet to be made, the increase of the convict camp personnel is postponed until next February or March. A proportionally greater number of convicts (probably an overage of 750 or 800) are therefore to be employed for the remainder of the biennium in order to accomplish as much work as is possible under the recent appropriations.

Program for Annual Meeting of California Section, A. W. W. A.

The eighth annual convention of the California Section, American Water Works Association, is planned for Oct. 5 to 8, inclusive, at San Jose, Calif. The present expectation is that the total number of exhibitors will exceed 60—last year's number was 51. Attendance at previous annual meetings has been in the neighborhood of 400 and a record-breaking attendance is expected this year.

The papers scheduled for presentation are as follows: "The San Jose Water System," Joseph R. Ryland, president, San Jose Water Co.; "Gunite-Covered Steel Pipe and Centrifugal Concrete Pipe for Laguna Beach Water District," E. A. Rowe, J. P. Lippincott Co., Los Angeles; "Simple Methods of Taking Flow Tests from Fire Plugs," R. A. Andrews, National Board of Fire Underwriters; "Symposium on Present Practice in Cross Connections"—discussion opened by Edward A. Reinke, California State Board of Health; "Method Devised for Removal of Sulphur from Well Water," Arthur Taylor, consulting engineer, Los Angeles; "Symposium on Water Shed Protection"—discussion opened by John Burt, general manager, Marin Municipal Water District. There will also be a symposium on "Water Main Installation Methods."

In addition to the exhibits in the Scottish Rite Auditorium, a part of the park opposite the auditorium has been set aside for field demonstrations where a variety of operations interesting to water-works men will be shown in a practical way.

Illinois to Buy Water Rights for Waterway Purposes

Negotiations between the Insull interests and the state of Illinois are completed except for the governor's signature, by which the state will purchase from the Insull interests property and water-power rights at Brandon Road, Dresden Island, and Marseilles on the Illinois River in order to facilitate the construction of the Lakes-Gulf waterway. The purchase price is stated to be $975,000.

Chippewa Falls Hydro-Electric Development Started

Construction of a new hydro-electric power plant for the Northern States Power Co. at Chippewa Falls on the Chippewa River in Wisconsin has been started. The Chippewa Falls plant will contain six 5,000-hp. units and will be located about 3 miles below the hydro-electric development at Wissota and will be operated "in step" with that plant using the water storage created by the Wissota dam. The head to be developed is 30 ft. The turbine runners are to have adjustable blades on order to increase their efficiency when operating under various conditions.

The work is to be carried on under the direction of the Byllesby Engineering & Management Corporation, of which H. W. Fuller is vice-president in charge of engineering and construction.

Large Floating Dry-Dock Launched in England

Three sections of the new floating dry-dock for the British naval base at Singapore were launched recently at Newcastle-on-Tyne in England. Four sections of the dock remain to be completed and will be launched before the end of this year. It is hoped to have the dock completed by May, 1928. Despite the great width of the 3,000-ton sections, the launching operation was carried out in much the same way that a vessel is launched. The completed dock will have a lifting capacity of 50,000 tons and will be the largest ever built by the manufacturers, who are leaders in that class of work. When the sections of the dry-dock have been fitted together and tested at Newcastle-on-Tyne, each section will be cut into two parts and towed to Singapore through the Suez Canal.

Hearing on Bridge Project at 57th Street, Manhattan, Is Held by Army Engineers

Application of the North River Bridge Co. for a permit to build a suspension bridge across the Hudson River at 57th St., New York City, was the subject of a public hearing at New York on Sept. 9 before a board of army engineers headed by Col. F. C. Boggs. The project was presented and supported by Gustav Lindenthal, chief engineer, who designed the proposed bridge, Francis Lee Stuart, and Samuel Rea, former president of the Pennsylvania R.R. The bridge would have a minimum high-water clearance of 175 ft. on a 500-ft. width, and 166 ft. on a 1,500-ft. width, this clearance decreasing to 150 ft. at the pierhead line. A clear span between pierhead lines is proposed.

Mr. Rea, in endorsing the project, said that studies for a bridge across the Hudson at Canal St. had been begun by the Pennsylvania R.R. 43 years ago, and further said that Thomas F. Ryan, Mr. Lindenthal and himself are the only survivors of the original incorporators of the company. Since the original planning, he said, conditions have so changed that steam railroad traffic is subordinate to other traffic and a bridge is now a necessity. Rapid transit connection with New Jersey must be established. Several New Jersey commercial organizations supported the project. The Port of New York Authority took no definite attitude.

Opposition to the application was voiced by a number of representatives of shipping interests, chiefly the Italian Line, the New York Towboat Exchange, and the Maritime Exchange. The representative of the former claimed that the bridge would render useless three present steamship piers on the New York waterfront. A clearance height of 215 ft. was asked for. The Maritime Exchange opposed the construction of any bridge south of Fort Lee, and others questioned whether there is present need for the proposed bridge with the traffic facilities provided by the Fort Lee bridge and the Holland tunnel, under construction.

Convention Program of A.P.H.A. Includes 160 Speakers

Preliminary plans have been completed for holding the 56th annual meeting of the American Public Health Association at Cincinnati, Oct. 17-21. In addition to two general sessions there will be six special sessions, four joint sessions, 22 sessions of the sections and eight dinner and luncheon sessions. Added to these is a program of scientific trips and entertainments, almost a dozen meetings and conferences of Ohio State groups and special groups within the A.P.H.A., together with numerous exhibits and demonstrations. Approximately 160 speakers are listed on the program.

Cook County Undertakes Study of Grade Separation

With more than 300 railway grade crossings on the busy highways of Cook County, Illinois, outside the city limits of Chicago, a survey of the financial and other features of a grade-separation program has been ordered by the county commissioners and is under the direction of Major Geo. A. Quinlan, county superintendent of highways. At present the county has plans for 14 grade separations at railway crossings. Of special interest is the fact that two of these include also highway grade separations, as 96th St. and 123d St. are to be carried under the Wabash R.R. and the Southwest Highway. Other grade separations at the intersections of heavy-traffic highways are under consideration.

According to a statement by Major Quinlan, the 300 railway crossings should be eliminated at the rate of 100 a year in connection with the county's program of building new highways and widening present highways to 40 ft. For this road improvement program a bond issue of $15,000,000 has been approved.

Longview, Washington, Bridge Plans Are Revised

New plans for the Columbia River bridge at Longview, Wash., have been submitted to the War Department, following the refusal of a permit on the plans first submitted (see *Engineering News-Record*, June 23, p. 1037). The new plans show a main span of 1,120 ft. clearance width and a clearance height varying from 175 ft. at the piers to 185 ft. at midspan; and anchor-arm spans of 700 ft. clearance width. The roadway is 27 ft. wide, for three lanes.

Chicago Scored By Jadwin on Metering Laxity

(*Concluded from p. 444*)

permit within 60 days. He stated that the permit subsequently issued was conditioned on the construction of sewage-works, which is being done, and on the metering program at issue. Other cities on the Great Lakes, General Jadwin said, returned to the lakes the water taken from them for city supply, they not affecting the lake levels. Moreover, Chicago uses 285 gal. of water per capita per day, whereas Washington uses only 137 gal. This high use at Chicago would seem to imply wastage and increases the volume of sewage to be treated. Consequently the War Department felt that metering was necessary.

In conclusion, General Jadwin assured the delegation that the Chicago petition for a modification of clause 8 of the permit had been referred to Col. Edward H. Schulz, district engineer at Chicago, for study and report.

Washington Notes

INVESTIGATIONS thus far in connection with the application of the Potomac River Corporation for a large development in the Washington-Harper's Ferry area indicate that the only public question involved is whether or not a careful study into the merits of the project by a competent agency is desirable in the public interest.

The data already gathered by the district engineer show clearly that it is in the interest of all concerned to extend a preliminary permit to some competent applicant. The development proposed by the Potomac River Corporation is much larger than that contemplated by the Norris bill. Much of its support came from the desire to develop power for the use of the government itself, which is a large consumer of electricity in the city of Washington. The development now proposed, however, is so large that only a fraction of the contemplated output could be put to use by the government itself. To make the large development feasible requires that practically all of the output be marketed. Were the government to develop the maximum resources of the Potomac it would have to embark in the power business on a very extensive scale outside the limits of the District of Columbia. Moreover, to conduct this power business efficiently would require on the part of the government agencies a degree of freedom from restrictive rules not often encountered in governmental operations. The government would be required to interchange energy on a constantly varying basis and under contracts possessing a considerable degree of flexibility so far as concerns their details. While it is possible that a governmental corporation could be created and endowed with extremely elastic powers, it is highly improbable that Congress would agree to such a charter. There is also doubt whether the executives of such a corporation could conduct their affairs without interminable difficulties with the Comptroller General and other accounting officers.

M. H. WHEELER, of Minneapolis, has notified the Federal Power Commission of his intention to apply for a preliminary permit for the Flathead Lake project. This is in conflict with the application made in 1920 by the Rocky Mountain Power Company. Mr. Wheeler asks that no rights be granted for a period of three months, during which he promises to perfect his permit. Action on the Rocky Mountain company's application has been delayed because of objections raised by irrigation interests.

THE Federal Power Commission had outstanding 293 licenses and 176 preliminary permits at the close of the fiscal year. Of that number 60 licenses and twenty preliminary permits were issued during the fiscal year ended June 30, 1927. The projects under license proposed to develop 1,926,587 primary horsepower, but 5,863,942 hp. are to be installed. Among the projects licensed during the last fiscal year were: The Mt. Shasta Power Corp., Pitt River No. 4, 120,000 hp.; Carolina Power & Light Co., Big Pigeon River, 105,000 hp.; Utah Power & Light Co., nine constructed projects, 58,145 hp.; Pacific Gas & Electric Co., three constructed projects, 35,700 hp.

Railroad Into Texas Oil Field Approved by Commission

Plans of the Panhandle and Santa Fe Railway Company for the construction of a new line from a connection with its present line at White Deer in Parson County, Texas, in a north and northwesterly direction 41 miles to a point in Hutchinson County, have been approved by the Interstate Commerce Commission. The applicant is a subsidiary of the Atchison, Topeka & Santa Fe Railway Company. It proposes to construct this line for the purpose of providing better transportation facilities for a proven oil territory known as the Roxana and Kelly oil field, 11 miles north of White Deer, also to serve the present development of the Badger and Texas Oil Company in the vicinity of the northern terminal.

Construction of the line is to begin at once and to be completed before June 1, 1928. Upon the completion of this segment, construction of the second section will be undertaken and it is expected that it will be completed before June, 1929.

Imperial Valley Plans to Add 4 Ft. to Levee Height

Preliminary plans for adding from 1 to 4 ft. to the height of the lower 12 miles of river-front levee along the Colorado River in Mexico have been announced by M. J. Dowd, chief engineer and general superintendent of the Imperial Irrigation District. The cost of this work, estimated at $80,000, is to be borne by the district and, if the necessary approval of the Mexican government is obtained, the work is to be carried out during the low-water period of the coming fall and winter. The proposed improvement includes heavy rock revetting along this portion of the levee system. Silt deposits in the lower river during the past two years have raised the bed of the stream so that this increased height of the levee is necessary, according to Mr. Dowd who points out that in the region involved the delta rises approximately one foot each year. Although the cost of this proposed addition to the levee height is to be borne by the American lands, it is stated that 200,000 acres of Mexican lands under these levees will be given additional protection by the proposed work.

Personal Notes

JAMES A. CHILDS, senior sanitary engineer of the Minnesota State Board of Health, has been appointed chief engineer and secretary of the Metropolitan Drainage Commission for St. Paul and Minneapolis, established for the purpose of making a study of sewage disposal, and is granted a two years' leave of absence from the state health board which he has served eighteen years, his place being taken by his assistant, O. E. BROWNELL. The Metropolitan Drainage Commission is co-operating with the University of Minnesota division of sanitation and the State Board of Health and engineers of the War Department in an investigation of sewage-disposal methods and studies for prevention of pollution of the Mississippi River.

J. F. KUNESH is now in Honolulu, Hawaii, as hydraulic engineer for the Water Resources Branch of the U. S. Geological Survey in co-operation with the Honolulu Sewer and Water Commission, and will have charge of the investigations, designs and comparative estimates of various surface water supplies for the city of Honolulu. Mr. Kunesh is a graduate of the University of Wisconsin. He has been with the U. S. Geological Survey in California and Arizona and later organized a Division Hydrographique of the Irrigation Service for the government of Haiti. He served two years with Layne & Bowler, water supply contractors, one year with the Florida East Coast Ry. as water supply engineer, and other positions including last year as assistant engineer with the Department of Water Supply, New York City.

ARTHUR E. ROBERTS, JR., who has been in the engineering department of the Ohio Department of Highways and Public Works for seven years, has been appointed resident engineer with headquarters at Jackson, Ohio. He fills the vacancy made by the transfer of A. W. Sherwood to Marietta.

WILLIAM BLANCHARD, JR., has been appointed district manager in charge of the Chicago office of McClellan & Junkersfeld, Inc., engineering and construction, as of Sept. 1, 1927. This office will be located at 100 West Monroe St., Chicago.

JAMES F. MILLER, of Vale, Oregon, has accepted a position with J. G. White Engineering Corporation to do investigation work for the Mexican Irrigation Commission in Mexico. Mr. Miller is a graduate of the State University of Iowa, and has been with the Bureau of Reclamation in Idaho and Oregon and with private irrigation works for a number of years.

EDWARD M. DURHAM, JR., St. Louis, Mo., has been elected senior vice-president of the Missouri Pacific with jurisdiction over all departments. Mr. Durham is a graduate of Lehigh University in the class of 1896. He began railroad work with the Chicago & Northwestern and has served in the engineering department of the Southern Ry. and the Atlanta, Birmingham & Atlantic and also has had service with the U. S. Railroad Administration. In 1924 he was appointed assistant to the president of the Missouri Pacific, becoming a vice-president in 1926.

A. W. ATWATER has withdrawn from membership in the firm of Martin & Warlick Co., engineering contractors, Chattanooga, Tennessee, to accept a position as engineer in the mechanical division of Stone & Webster, Inc., Boston, Mass. Mr. Atwater's experience has been quite varied in power plant and architectural engineering.

A. G. SHAVER, signal engineer, has opened an office at 310 So. Michigan Ave., Chicago, as consulting engineer in railway signaling, train control and means of economy in train operation.

MAJOR EUGENE REYBOLD has been appointed first assistant to Major DeWitt C. Jones in the Buffalo district of the United States Engineer Department. Major Reybold has been in the Army War College in Washington, D. C. At Buffalo he succeeds MAJOR A. B. JONES, who was called recently to serve on the flood control board of the Corps of Engineers at Washington.

NATHAN L. SMITH, who has been assistant to Steuart Purcell, chief of the Bureau of Highways, Baltimore, Md., has been appointed acting chief of the Bureau of Highways following Mr. Purcell's appointment to membership on the Maryland Public Service Commission, as noted in these columns Aug. 25. Before the Bureau of Highways was established, Mr. Smith was for some time chief engineer of the old Paving Commission of Baltimore.

STROBEL STEEL CONSTRUCTION CO., Monadnock Block, Chicago, announces that an office has been opened at 30 Church St., New York, in charge of J. I. Vincent as resident engineer, to handle business on the Atlantic Coast. Mr. Vincent will represent the company on its contract work and also in securing contracts for the design and construction of bascule bridges in particular.

M. C. SJOBLOM, formerly sanitary engineer in the Illinois State Department of Purchases and Construction, has taken up private practice in civil and sanitary engineering, with offices at 1208 Hartford Building, 8 So. Dearborn St., Chicago.

F. F. MENGEL, division engineer of the Wisconsin State Highway Division, located at Wisconsin Rapids, Wis., for the past 12 years, has resigned to become a member of the firm of Mengel & Vogt, contractors, at that city.

G. E. ELDRED has been appointed acting division engineer of the Wisconsin State Highway Division, at Wisconsin Rapids, Wis., to succeed F. F. Mengel, retired.

Engineering Societies

Calendar

Annual Meetings

AMERICAN WELDING SOCIETY, New York City; Fall Meeting, Dever, Colo., Oct. 3-6, 1927.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual meeting, Dentroit, Mich., Sept. 19-23, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Columbus, Ohio, Oct. 12-14, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Fall meeting, Birmingham, Ala., Oct. 17-19, 1927.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Dallas, Texas, Nov. 14-18, 1927.

ASPHALT PAVING CONFERENCE: Under the auspices of the Asphalt Association and Association of Asphalt Paving Technologists; annual conference Atlanta, Ga., Nov. 28-Dec. 2, 1927.

HIGHWAY RESEARCH BOARD, NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual meeting, Washington, D. C., Dec. 1 and 2, 1927.

THE MISSOURI CONFERENCE ON WATER PURIFICATION will hold its third annual meeting at Sedalia, Mo., Oct. 13 to 15, and its program will include maintenance of sewage-disposal works as well as problems relating to water purification plants. W. Scott Johnson, of the Missouri State Board of Health, at Jefferson City, Mo., is secretary of the conference.

THE IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION will hold its annual meeting at Council Bluffs Sept. 28-30. Chris Jensen, of the Council Bluffs city water-works, is in charge of local arrangements including the exhibit space.

THE CENTRAL STATES SECTION OF THE AMERICAN WATER WORKS ASSOCIATION will hold its annual convention Sept. 15 and 16 at Akron, Ohio. Papers include a description of the Mahoning Valley Sanitary District, by W. H. Dittoe, chief engineer of the district, Youngstown, Ohio; studies of retention periods for coagulation of Lake Erie water, by W. C. Lawrence, superintendent of filtration and sewage disposal, Cleveland, Ohio; water softening plant and pumping station improvements at Fostoria, Ohio, by J. F. Laboon, of the J. N. Chester Engineers, Pittsburgh, Pa.; elimination of errors in the orthotolidine method, by F. R. McCrumb, chief chemist, LaMotte Chemical Products Co., Baltimore, Md.; the metal spraying process, by C. V. Witt, president, Witt Steel Co., Greensburg, Pa.; the water-works at Mount Clemens, Mich., and Akron, Ohio; and discussion of sections of the water-works manual by J. W. Ellms, engineer of water purification and sewage disposal, Cleveland, Ohio, and J. N. Chester of Pittsburgh, Pa.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Plans Being Made for Western Road and Equipment Show

Tentative plans are under way for a road and equipment exposition to be held in Los Angeles, March 7-11, 1928. This show will take the place of the All-Western Road Show held for the past two years in San Francisco in the fall. In contrast to the latter show, however, the exposition that is being planned is broader in scope, covering all branches of general construction. It is stated that these dates have been chosen in order to avoid conflict with the Road Show in Cleveland in January and the show in Wichita, Kan., in February.

As in San Francisco, the show will be held in large tents on grounds ample in size for demonstration purposes. In addition to this, the site contains an auditorium with a seating capacity of 1,000 and an administration building which can be used for conferences. Arthur E. Welch, secretary for the show, has been in the east for the purpose of interesting manufacturers in the show.

Vulcanite to Make Super Cement

The Vulcanite Portland Cement Co. has announced that machinery is being installed in its plant at Vulcanite, N. J., for the manufacture of "Super Cement," in addition to its regular product of portland cement. Production is expected to be under way by Oct. 1.

Super cement is the name given to a product discovered in 1914 by G. F. Goddard, an English investigator. Licenses for its manufacture have also been issued to the Bessemer Cement Corporation of Youngstown, Ohio, the Peerless Portland Cement Co., of Detroit, Mich., and the Marquette Cement Manufacturing Co. of Chicago.

Super cement is made from normal portland cement clinker by essentially the same process as is used in making portland cement. No waterproofing compounds are added. The essential difference between super cement and portland cement is that a portion of the gypsum used to regulate the set is displaced by a special plaster treated with oak gall tannin in small percentage. When this treated plaster, formed into slabs, is dried under rotary kilns, it is called catacoll and is added with the remaining gypsum to the portland cement clinker so that the SO_3 content is maintained below the specified maximum. It is claimed that the tannin influences the constituents of the clinker to form a hydrate of a much greater colloidal nature than that of portland cement. Super cement meets the standard physical specifications for portland cement except the definition, and, while no claim is made for greater strength in earlier periods, concrete made with it, it is claimed, will run slightly stronger at later periods. The main claim made for the material, however, is that it is very much more workable and produces a greater density, and that it also has waterproofing and oilproofing qualities.

Vulcanite super cement will be packed in multi-wall paper bags and will sell for 75c. more per bbl. than portland cement.

Business Notes

ARTHUR F. KING, formerly director of sales, Marion Steam Shovel Co., has resigned to take over the sale of the products of the Osgood Co. and the General Excavator Co. for the Pacific Coast section. A new company incorporated as the Arthur F. King Co. has been formed with the main office located in San Francisco. Distribution will be established in the chief cities of California, Oregon, Washington, British Columbia, Arizona, Nevada, Idaho, and Montana. Repair and service stocks are to be carried at all points.

ROBERT E. KINKEAD has resigned as chief engineer, welding division, Lincoln Electric Co., Cleveland, Ohio, to engage in consulting engineering in connection with electric arc welding, with office at 3030 Euclid Ave., Cleveland, Ohio. Mr. Kinkead joined the Lincoln Electric Co. in 1913, immediately after his graduation from Ohio State University, and with the exception of a few years, during which he was in the United States Navy, then chief engineer, the Mitchell Co., Chicago, and later consulting expert for the Western Electric Co., he has been continuously with the Lincoln Electric Co.

AKRON BARROW CO., Cleveland, Ohio, announces that, effective Sept. 1, its name will be changed to the GENERAL WHEELBARROW CO. The name is a result of the development of the company into a manufacturer of a broad and inclusive line of wheelbarrows whereas at its inception it manufactured only heavy duty wheelbarrows for foundries and similar purposes. The management remains under those who have been responsible for the company's past progress. No refinancing nor reorganization has taken place, nor is any contemplated according to the statement.

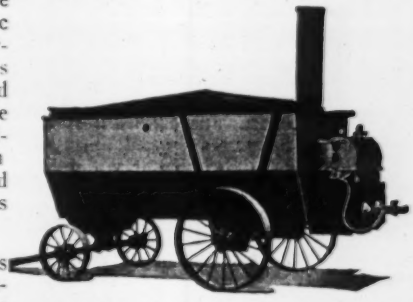
STRAUSS BASCULE BRIDGE CO., Chicago, announces that it has changed its corporate title to STRAUSS ENGINEERING CORP. The officers of the corporation are Joseph B. Strauss, president, and Charles A. Ellis and Clifford E. Paine, vice-presidents. The corporation will specialize as heretofore in all types of movable, fixed and long span bridges, making a specialty of toll bridge projects, it is said.

NICHOLAS W. DUNCAN, chairman, board of directors, Marquette Cement Mfg. Co., died Aug. 28. Mr. Duncan was 71 years old.

New Developments

Asphalt Melting Kettle Made In 300 and 550 Gal. Capacity

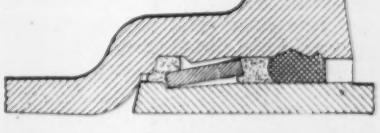
A new oil-burning asphalt-melting kettle for road construction work has recently been built by Littleford Bros. Co., Cincinnati, Ohio. It is available in two capacities of 300 and 550 gal. each. Two oil burners will melt batches of asphalt in a much shorter time than is possible with a wood or coal fire is



the claim of the manufacturer. The kettle carries a fuel tank of 20 gal. capacity and is mounted on roller bearing wheels and high carbon steel axles. Solid steel wheels are standard equipment, but solid rubber tire mounting is available if desired. A warming hood to take the place of the standard cover and a barrel hoist for raising barreled materials are accessories which can be furnished.

Precalked Joint for Cast Iron Pipe Improved

The addition of a "bead" to the spigot-end of its precalked joint cast

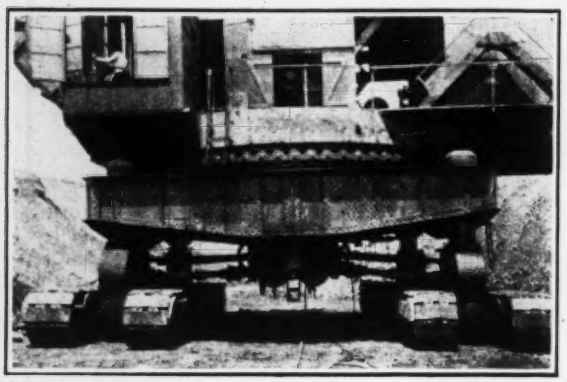


iron pipe in sizes above 3 in. is the latest improvement announced by the McWane Cast Iron Pipe Co., Birming-

ham, Ala. As indicated in the accompanying sketch, calking the factory-made lead-and-jute joint forces the wedges in the precalked joint into the recess cast about the spigot end of the pipe and thus locks the spigot end into the precalked joint.

Huge Electric Shovel Uses 12-yd. Dipper on 60-ft. Stick

The car body and crawlers of what is claimed to be the largest electric stripping shovel ever built are shown in the accompanying illustration. The shovel, which is a Marion new type 5430, is mounted on crawling traction trucks which are equipped with Marion hydraulic equalizing jacks to automatically



hold the machine level while traveling or working on rough or uneven ground surfaces. The machine carries a 90-ft. boom, 60-ft. dipper handle and 12-cu.yd. dipper. It is claimed that it will strip over-burden up to approximately 50 ft. in depth.

The electrical equipment, which is manufactured by the General Electric Co., consists of two 255-hp. motors on the crowd. The motor generator set which furnishes power to the individual motors has a continuous rating of 700 kva. The machine is to be used by the Northern Illinois Coal Corporation, Chicago, and was built by the Marion Steam Shovel Co., Marion, Ohio.

Concrete Floors Protected and Cured by New Material

For protecting concrete floors, especially of decorative concrete, during the curing period, the Master Builders Co., Cleveland, has developed a new material known as "Stainproof." Often during the curing period, painters, plasterers and other trades move across and over new work. To prevent this damage, sand, sawdust and building paper coverings have been used, but the Master Builders Co. believes they are much less efficient protection than is the new material.

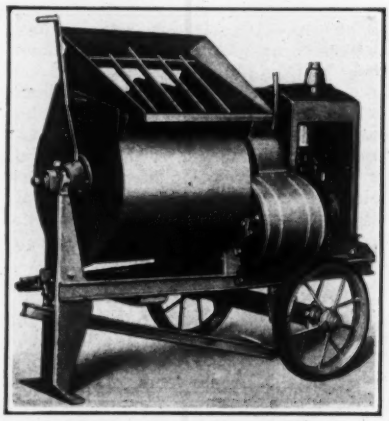
Stainproof is a jelly-like material. Applied to the surface in a paint-like film 36 hours after the final troweling, it dries to form a non-porous, viscous film which is said to be so tough that the heavy traffic which new floors have to bear cannot grind through it. Stainproof is removed when the building is ready for occupancy.

Meanwhile, it is claimed that the Stainproof has aided proper curing by sealing the original moisture in the topping, thus preventing too quick drying. Although developed principally for protecting and curing Master Builders Colormix floors, Stainproof is said to be suitable for use on new terrazzo floors, marble and stone floors, and on tile floors.

New Mixer Will Supply Mortar For Fifty Bricklayers

A new one-bag mortar and plaster mixer for which is claimed speed, portability and long wear, is a new product of the Marsh-Capron Co., Chicago. It is claimed that the new mixer in the hands of a single operator will easily handle the requirements of 12 to 14 plasterers or 50 bricklayers. The machine will turn out a thoroughly mixed 4-hod batch of any kind of mortar or plaster in two minutes' time, as a result of its special design of mixing hopper and blades and a 24 r.p.m. speed.

Two styles of mounting are provided—a two-wheeled trailer mounting, equipped with rubber-tired wheel, cushion springs and roller bearings and a steel caster mounting for inside work. The drum is supported on self-aligning trunnions, carried in bearings on the main frame. These trunnions are bored and form the bearings for the hoe shaft. The hoe shaft is thus relieved of all loads or strains except the mixing ac-



tion. Each mixing hoe is formed of three steel bars, and these mixing hoes with their end scrapers are set at a close fit to the barrel and ends of the drum so as to thoroughly scrape and clean the drum at every revolution. A discharge spout built as part of the drum confines the batch to a narrow stream permitting discharge into wheelbarrows. A two-cylinder hopper-cooled LeRoi gasoline engine is provided as standard equipment and the engine to clutch counter shaft drive is by sprocket and chain.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL HARDWOOD LUMBER ASSOCIATION, Chicago; Annual Convention, Chicago, Sept. 15-16.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Semi-annual meeting, Aviation Country Club, Detroit, Sept. 19-21.

AMERICAN PAINT & VARNISH MANUFACTURERS ASSOCIATION, Philadelphia; Annual Convention, Atlantic City, Oct. 24-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York; Annual convention, Pinehurst, N. C., Oct. 25-29.

NATIONAL ASSOCIATION OF MANUFACTURERS; Annual meeting, Chattanooga, Tenn., October 25, 26 and 27.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 16-19, 1928.

New Publications

Chains and Transmission Equipment—CHAIN BELT CO., Milwaukee, has issued Catalog No. 220 to supplement its Catalog No. 210. The new catalog contains new list prices effective July 1, 1927. It contains in its 140 pp. illustrations, tables and all essential data for ordering, the company's complete line of chains, spur gearing and sprockets.

Coagulation and Water Treatment—CHICAGO CHEMICAL CO., Chicago, has issued a 6-p. pamphlet entiled "The Aluminate-Alum Coagulation of Water." It was prepared by C. H. Christman, chemist for the company.

History of Armco—AMERICAN ROLLING MILL CO., Middletown, Ohio, has published a 48-p. booklet entitled "Armco Ingot Iron—Its History and Service," which contains a description of Armco ingot iron, many illustrations of the company's plants. Included also is information on the various uses to which ingot iron is put, together with a description of a trip through the company's plant.

Steel Trackage—SWEET'S STEEL CO., Williamsport, Pa., has published its 1927 general catalog. The catalog, in its 59 pp., gives complete information on the company's steel rails, portable track, mine ties, angles and other track accessories.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Heavy Drop in Imports of Belgian Cement

A SHARP decline in cement importations is indicated in preliminary figures released Aug. 25 by the Department of Commerce.

Since Belgium furnishes about 44 per cent of all foreign cement used in this country, a report issued Aug. 22 by the Cement Information Bureau, 25 Broadway, New York, N. Y., proves interesting.

The bulletin of the Bureau is based on public American Consular records, Brussels, Belgium, Aug. 11, showing that 116,737 bbl. were shipped to the United States in July, 1927, against 277,233 bbl. for the same month last year. This represents a decrease of 160,496 bbl. or 58 per cent.

The report of the Bureau, in part, is as follows:

"For home consumption the present mill price is 175@180 francs, or 89@91c. per bbl. Prices have not been cut because the trade is in such flourishing condition. There was a price increase on July 1 of 5c. per bbl. and another 5c. advance is promised in the near future. The demand exceeds the capacity by 30 per cent. The profits for the first six months of 1927 are said to be greater than for the entire year 1926.

"Prices to the United States range from 81 to 91c. per bbl. f.o.b. Belgian mill. At the same time the delivered price in Holland, including paper bags, was 94c.

"The *Revue du Travail*, official labor bulletin of the Belgian government, in its July issue, attributes the present marked decline, as compared with last year, in shipments of cement to the United States as 'The consequence of the campaign followed by the American cement mills against imported cements, the major part of which are of Belgian origin.'

"Railroad rates (Belgian) are today 15 per cent lower than in 1913 and construction costs are about at the prewar levels. Wages in the majority of the mills are at present 10½c. per hr."

Price per bbl. of four bags and destination of each of the thirteen shipments received from Belgium during July are as follows:

	C.I.F.		C.I.F.
1. Boston	$1.82	9. Honolulu, H. T.	$3.25
2. Boston	1.82	10. Honolulu, H. T.	2.20
3. Philadelphia	1.90		F.O.B.
4. Miami	1.90	11. Belgian Mill	.816
5. San Francisco	2.05	12. Belgian Mill	.88
6. Gray Harbor	2.04	13. Belgian Mill	.926
7. New York	2.65		
8. San Juan, P.R.	2.13		

Boston appears to have gotten Belgian cement at a lower figure than the other seven cities mentioned in the table. This recalls the break in the Boston cement market which occurred in July (see *E.N.-R.*, issue of July 7, 1927, p. 40). The price to contractor, on the occasion referred to, dropped from $2.30 per bbl. to $2, in one month. The August price of $2.05 per bbl. reflected a slight improvement in the situation; this quotation still holds for carload lots, to contractor, f.o.b. Boston.

Belgium, Norway and Denmark, together, furnished 95 per cent of all cement imports for July, 1927. Norway shipped 70,134 bbl. or 40 per cent and Denmark, 19,971 bbl. or 11 per cent.

Unit Bids From Construction News

Concrete paving in Seattle, Wash., 26,600 sq.yd. of 6-in., $2.86. Grading and 7.5-in. concrete paving in Burnaby, B. C., 2.9 in. x 18 ft., $5.90. In Abilene, Tex., $2.90.

Asphaltic concrete, 2-in. on 6-in. concrete paving, 24,910 sq.yd., $2.79.

Roadwork in Clay County, Iowa: Earth excavation, 73,942 cu.yd. $0.287@ $0.322; loose rock excavation, 1,900 cu.yd., $1.00; overhaul, 75,000, $0.02; culvert labor, 743 lin.ft., $0.75.

2,600 seats for school auditorium in Murray, Ky., @ $4.34.

Grain Elevator, 114 ft. high with 8 large circular bins and 4 small bins each 90 ft. deep, 52,000 bu. capacity, reinforced concrete, $150,000.

French Construction Cost Increase Since 1914

The Building Materials Commission gives the following figures, showing building costs as of January, 1927, compared with those of August, 1914, the latter equaling 100:

Excavation	143
Masonry	1,250
Building hardware	184
Wood work	137
Roofing and plumbing	128
Cabinet work	139
Flooring	119
Tiling	116
Marblework	132
Heating installation	132
Water piping	120
Electricity	197
Mirrors and glass	136
Painting materials	132

Items of Railway Costs

Expenditures for new equipment and property improvements, made by Class 1 railroads of the United States during the first quarter of 1927, are compared with those of the same period last year, as follows:

	1927	1926
Freight cars	$18,192,000	$44,500,000
Railway and structures	99,676,000	90,800,000
Additional track	30,145,000	30,900,000
Heavier rails	8,275,000	7,200,000
Shops, engine houses, machinery and tools	10,941,000	8,200,000
Locomotives	19,771,000	.....
Passenger cars	12,346,000	.....

Steel Output Declines—Prices Hold

FOUR per cent less steel, in ingot form, was manufactured during the first eight months of 1927, than was produced by the nation's mills in the same period last year.

Sales of fabricated structural steel, booked by the principal manufacturers during the period Jan. 1 to Aug. 1, 1927 were 5 per cent greater in tonnage than orders covering the corresponding period of 1926.

The average price of the principal hot-rolled steel materials (bars, plates and shapes) is now $1.80 per 100 lb., Pittsburgh; a trifle over this figure represents the average for the first eight months of 1927, against $1.95 average for the period Jan. 1 to Sept. 1, 1926.

Following are the production figures for openhearth and bessemer ingots, reported by the American Iron and Steel Institute, for companies which made 95.4 per cent of the output in these two classes during 1926:

	1927 Tons	1926 Tons
January	3,586,923	3,908,529
February	3,607,433	3,579,860
March	4,292,134	4,226,471
April	3,906,486	3,883,472
May	3,830,493	3,717,906
June	3,308,524	3,534,926
July	3,032,138	3,437,875
August	3,311,241	3,772,328
Eight months	28,875,372	30,061,367

Fabricated structural steel bookings, computed by the Department of Commerce from reports of the principal manufacturers, are as follows:

	Bookings		Shipments	
	1927 Tons	1926 Tons	1927 Tons	1926 Tons
January	171,720	184,440	174,900	206,700
February	219,420	184,440	181,260	190,800
March	209,880	209,880	200,340	244,860
April	238,500	222,600	209,880	244,860
May	206,700	235,320	213,060	238,500
June	203,520	232,140	232,140	267,120
July	311,640	219,420	232,140	263,940
Seven months	1,561,380	1,488,240	1,443,720	1,656,780

Per Cent Change from 1926

(Contract Totals Entire U. S.)

	Jan.-June	July-Aug.
Water-works	+5	+4
Sewers	+17	+31
Bridges	+90	—27
Excavation	+142	—33
Roads	+9	—21
Buildings:		
Industrial	—33	+43
Residential	—5	—3
Other	+11	—1
U. S. Government	+1	—41
Unclassified	+52	+16
All	+3	—3

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total U. S.
September 15, 1927.	$34,119,000	$28,875,000	$62,994,000
September 8, 1927.	24,551,000	35,468,000	60,019,000
September 16, 1926.	20,307,000	33,648,000	53,955,000
Jan. 1 to date			
1927	902,148,000	1,338,767,000	2,240,915,000
1926	808,447,000	1,259,885,000	2,068,332,000

E.N.-R. Index Numbers

On September 1, 1927

COST	VOLUME
203.60	306
Last Year 208.30	Last Year 252

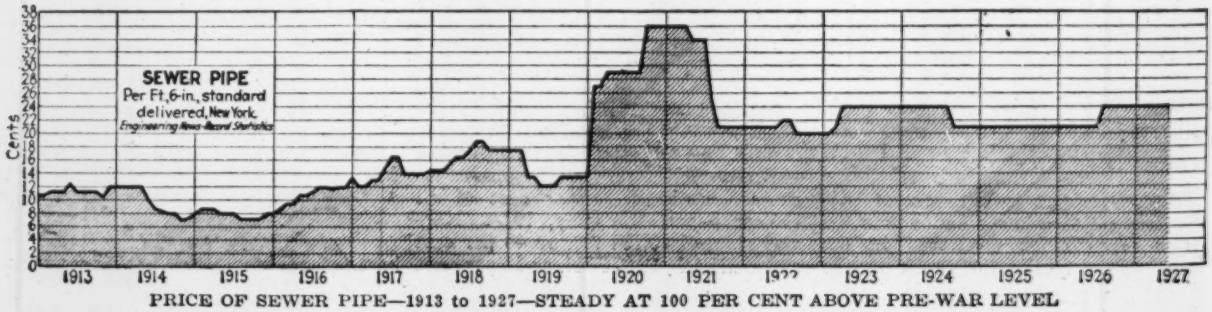
The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction Costs.

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, per 100 lb.	$3.34	$3.75	$4.00	$3.10	$3.35	$3.87½	$3.10	$3.00	$4.00
Structural rivets, per 100 lb.	5.00	4.00	4.75	3.60	3.75	4.64	5.50	5.25	5.50
Reinforcing bars, per 100 lb.	3.24	2.99	2.75	2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in., lap weld, discount from list	48%	40%	54%	51%	48%	41%	42@53.8%	48%	.....
Cast-iron pipe, 6 in. and over, per net ton	44.60	3[illegible].50	54.00	40.20	46.50	56.50	43.00	55.00	41.00
Concreting Material									
Cement, without bags, per bbl.	2.35†	2.40	2.05	2.05	2.22	2.85	2.51	2.65	1.41
Gravel, ¾ in., per cu.yd.	1.75	2.20*	2.38	2.00	1.25*	1.90	1.80	1.25	1.90*
Sand, per cu.yd.	1.00	1.75	2.00	2.00	1.25†	1.00	1.40	1.25	1.35*
Crushed stone, ¾ in., per cu.yd.	1.85	2.50*	2.83	2.00	1.25*	2.50	1.70	3.00	2.00†
Miscellaneous									
Fir, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	.....	.....	.....	38.50(S4S)	39.75	34.25	27.00	24.50	55.00†
Pine, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	62.00†	34.00	56.00†	.....	.....	.....	.....	.....	.....
Lime, finishing, hydrated, ton	17.45	24.50	19.00	20.00†	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@2.35‡	1.35	1.82	1.50†	1.70	2.70‡	1.70	2.80‡	10.00*
Common brick, per M	17.00†	12.50	13.60	12.00†	13.75†	8@12	14.00	14.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0724†	.103	.....	.072	.085	.....	.10	.10
Hollow partition tile, 4x12x12, per block	.1027	.0724†	.103	.076†	.072	.085	.108	.09	.08
Linseed oil, raw, 5-bbl. lots, per 7½-lb. gal.	.86¼	87¾	+1.10	—.81	.90¾	1.01	.92	.98	1.03
Common Labor									
Common labor, union, per hour.	.90⅜	.30	.....	.90	.....	.....	.62½	.70	.....
Common labor, non-union, hour.	.....	.25	.30@.50	.82½	.45@.60	.31¼@.50	....	.62½	.30@.35

*Ton. †Delivered. ‡280-lb. net. +Advance. —Decline.

THE seasonally downward movement in prices of building materials continues without notable decline in any single group. Increasingly heavy production of cement, glass, lime, plaster and building stone, in the New York district particularly, encourages the present declining trend. Steel orders on books of the United States Steel Corporation as of the last day in each month, have shown steady increase since June 1, 1927. While this consistent gain shows improvement in steel business, the month to month tonnages are lighter than in 1926. Unfilled steel orders as of Aug. 31, 1927, were 3,196,037 tons, against 3,142,014 for July 31 and 3,542,335 tons, Aug. 31, 1926. Steel prices remain steady despite slight recession in demand for plates, railway material, and oil country goods. Pig-iron demand is slow; this condition is reflected in the declining price of cast-iron pipe. The accompanying diagram shows fluctuations in prices of sewer pipe over a period of fifteen years. This material is one of many that show a tendency to stabilize at approximately 100 per cent above the 1913 level. The price in 1913 ranged from 11 to 12c. per ft. for size specified, while the current price is 24c. per ft. with 22c. applying on large shipments.



PRICE OF SEWER PIPE—1913 to 1927—STEADY AT 100 PER CENT ABOVE PRE-WAR LEVEL